AUGUST • 1954

Symposium—
Gasoline Additives

PETROLEUM REFINER

REFINING | PETROCHEMICALS | NATURAL GASOLINE

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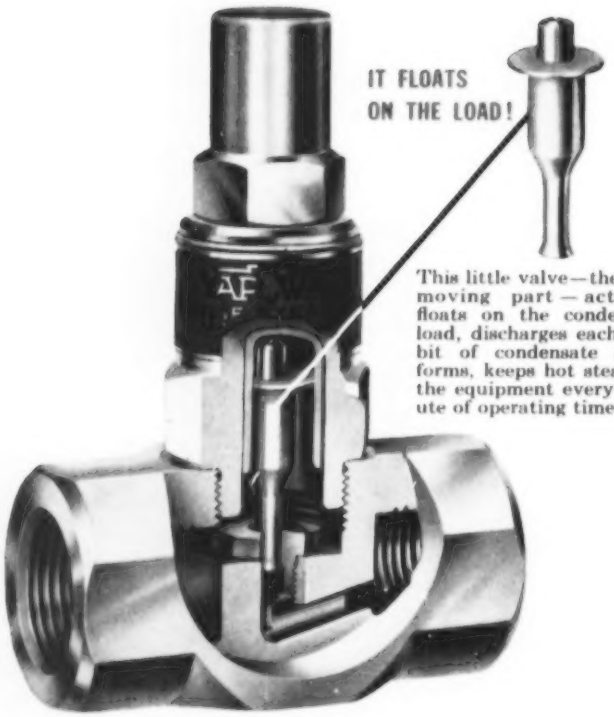
3000 impulses help keep mid-west refinery "on stream"



This little valve—the only moving part—actually floats on the condensate load, discharges each tiny bit of condensate as it forms, keeps hot steam in the equipment every minute of operating time.

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impulse® steam trap

Volume 33, No. 8 August, 1954

PETROLEUM
REFINER
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A Quick Look at This Issue

GASOLINE ADDITIVE SYMPOSIUM

The subject of gasoline additives is one on which almost every oil company is spending considerable time and money. Yet, with all this activity, there appears to be a wide divergence of opinion. Disagreements extend not only to methods to control pre-ignition but also to the relative importance of the problem. Certainly there are many opinions, but it is not possible to present all of them here. The three articles chosen represent the thinking of three companies on this subject.

- **Combustion Chamber Deposit Control . . .** The views of Standard Oil Development Company on the entire pre-ignition problem are given. It is felt that this problem is of less magnitude than the one of detonation. Where pre-ignition does occur, the soundest solution is the use of fuels and lubricants that deposit less material in the combustion chamber. While phosphorus additives are effective, some types of phosphorus compounds reduce the octane number and have a deleterious effect on engine parts. **Page 88.**

- **Improve Fuel with Phosphorus Additives . . .** It is the opinion of Shell Oil Company that the pre-ignition problem is widespread and that the most effective known way to control it is with the use of phosphorus additives. Tricresyl phosphate has given the best results. Records do not indicate that engines have suffered any harmful effects from gasoline containing this additive. **Page 92.**

- **How Effective Are Gasoline Additives? . . .** The Atlantic Refining Company has evaluated several types of gasoline additives both in the laboratory and in the field. Of the additives tested, the phosphorus compounds have been found to be most effective. It is felt, however, that more testing is needed for final evaluation of all the effects of additives of the various types. **Page 97.**

This interesting and informative symposium begins on **Page 87.**

Mixers for Large Tank Blending . . . Here are heretofore unpublished data on the techniques and theories of mechanical mixing in large tanks. The author, Dr. J. H. Rushton, is the top authority in the field, and has done an excellent job of bringing the entire problem into sharp focus. All the necessary data are given to properly evaluate the magnitude of tank stratification in various services such as TEL blending. With the design information presented,

→ Turn Page →

engineers can easily determine their own mixing needs and properly design the equipment necessary to solve these problems. **Page 101.**

Thermo Data for Petrochemicals, Part XX . . . This part, *Ketene—Acetone Equilibrium*, presents both thermodynamic and thermochemical data on ketene and acetone. Those who followed the series, "Thermochemistry for the Petrochemical Industry," will recognize this as an addition. The series title changed since thermodynamic data are also included. The data presented are useful and many will want to obtain reprints of the previous parts of this series. **Page 109.**

What is the Octane Picture? . . . In this two-part series are the answers to the billion-dollar question. Part I reviews the record of increased gasoline octanes in past years, and then offers predictions for the years through 1958—priceless help for expansion planners everywhere. Part II presents hitherto unpublished information on the effects on road octane ratings of certain controllable gasoline quality variables. In addition, it outlines laboratory and road testing programs designed to obtain optimum utilization of gasoline octanes. **Page 111.**

Understanding the Chemistry of Petrochemical Reactions, Part 15 . . . Here is an article dealing with the Oxo process. This is the process by which aldehydes can be formed by the treatment of an olefin with carbon monoxide and hydrogen over a cobalt catalyst. Additional hydrogenation of these aldehydes results in the formation of more valuable products—primary alcohols. Interest in this process is high because it can be used to produce many aldehydes, alcohols and acids which at present can be produced by no other commercial process. The first U. S. plant started operation in 1949. However, at the present time, there are about six plants in operation. For more information, see **page 113.**

Cavitation Versus NPSH Requirements . . . Serious difficulties from cavitation can often be eliminated by modifying NPSH requirements. Previous REFINER articles have given much helpful information on the fundamentals of NPSH. In this paper, the author shows the relationship between NPSH and cavitation and details a simple procedure for minimizing the cavitation problem. The effect of the type of liquid pump is shown graphically, and these curves will become a part of your permanent files of data. **Page 117.**

Conoco Enlarges Lake Charles Plant . . . This refinery has been quadrupled in crude capacity and now makes such special products as dodecene, benzene and toluene. Construction of a nearby gas processing plant will increase the volume of field condensables to be processed in the refinery. **Page 119.**

Fouling of Heat Exchangers . . . You might think that finned tubes would be far-and-away more subject to fouling than plain tubes. But these test results show that fouling factors for both bundles are about the same. What's more, you can use the same old solution cleaning methods on finned tubes and get just as good results. **Page 123.**

Recycle Process Material Balance . . . The graphs in this article will save a lot of time in translating single-pass data to a recycle basis. Starting with data from a once-through operation, the author derives mathematical expressions and graphs which clearly show the relationship between conversion, efficiency and yield of a process. **Page 127.**

Chart Solutions in Flange Design . . . An experienced designer has dug deep in his private bag of tricks to produce these seven nomographs. Author of a highly popular article, "How Flanges Work, and Why They Leak" published in PETROLEUM REFINER last year, he is eminently qualified to handle his subject. For an important addition to your permanent notebook, turn to **page 131.**

Hydrocarbons from Cellulosic Wastes . . . The second part of a series on hydrocarbons from carbohydrates begins on **page 135.** This part deals with the nature of the products—gasoline, gas oil, lube oil, etc.—made in this project.

Petrochemical Supply and Demand . . . Here is good reading on the outlook for the petrochemical industry. It appears that supply is catching up with demand in some fields. The tight market that is likely to result requires a close look at the competitive position of some of the integrated and non-integrated companies, especially as concerns those producing ethylene and its products. Careful analyses of pricing and cost appraisal are necessary. These are all covered on **page 139.**

Valuable Intermediate: Ketene . . . While ketene is produced in relatively large quantities, it is not a well-known chemical. Probably the reason for this is that it is not marketed as ketene. The production is used on the plant site as an intermediate for the production of acetic anhydride and acetate esters. This article will help you become better acquainted with this chemical. It includes a complete description of a petrochemical plant designed by Courtaulds, Ltd., of England for the production of ketene from isopropanol. It is both interesting as well as informative reading. **Page 143.**

Should You Have an Employe Publication . . . Sooner or later, every successful plant must face up to this question. Too often, it is answered by somebody's decision to start a magazine on the grounds that it might help and can't hurt. For an approach to the question that may save you time and money, turn to **page 84.**

How to Be Interviewed . . . More and more executives are being asked for interviews. Some aren't faring so well. Are you? If not, here are six helpful recommendations. **Page 86.**

Avoid Sunstroke and Heat Exhaustion . . . They aren't the same things, you know. The symptoms are different, the treatment is different. Here's how to recognize the maladies and, also important, how to avoid them. **Page 191.**

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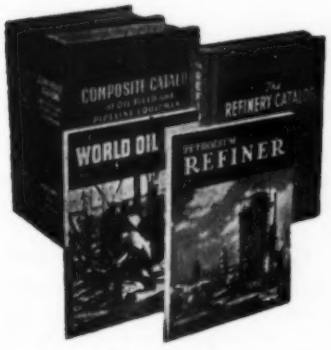

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PETROLEUM REFINER and The REFINERY CATALOG for the refining-natural gasoline-petrochemical industry

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Bob's B. S. & W.

What's the Deal on Markets? A recent swing through the Sabine River and Louisiana refining areas has left me somewhat confused on just what the market situation really is for refined products. On every hand there are reports that competition is murderous, price wars are breaking out everywhere, and the over-all situation is bleak indeed. Yet in the areas visited, I found few signs of such hysteria. People are doing some worrying about the increasing competitiveness, one major has ordered a ½-cent-per-gallon price cut in gasoline, but there have been no price wars and no one seems to be really rocking the boat.

Just what is the market picture? The reports from refining executives across the country show the full scale of sentiment from pessimism to optimism. Summarizing, here are a few of the opinions expressed:

- *Refiners just now hitting competitive economy already reached in other industries.*
- *Too much crude in last 12 months caused excessive inventories.*
- *Inventories not really excessive, since wartime backlog on tankage construction now being caught up.*
- *Gain in inventories about in line with gain in crude capacity.*
- *Surplus in inventory is mostly regular grade which needs to be reblended to premium.*

★ ★ ★

Bouquets to Lew. Other people think a lot of our Contributing Editor too. Dr. Lewis Hatch, a part-time staffer with us and a full timer for the University of Texas, is the producer of the highly popular series "Petrochemical Reactions." A recent communique indicates that one major oil company is so impressed with his petrochemical knowhow that he has been engaged to give an intensive two-week course on the subject to their engineers. Then we recently heard where another one of our authors achieved fame and fortune through the avenues of his article published in REFINER. Seems the readers in a refinery in Belgium were impressed with the article and borrowed him for a couple of months to help them over the hump on a problem. Just goes to show you that there are more advantages than meet the eye in this business of writing articles.

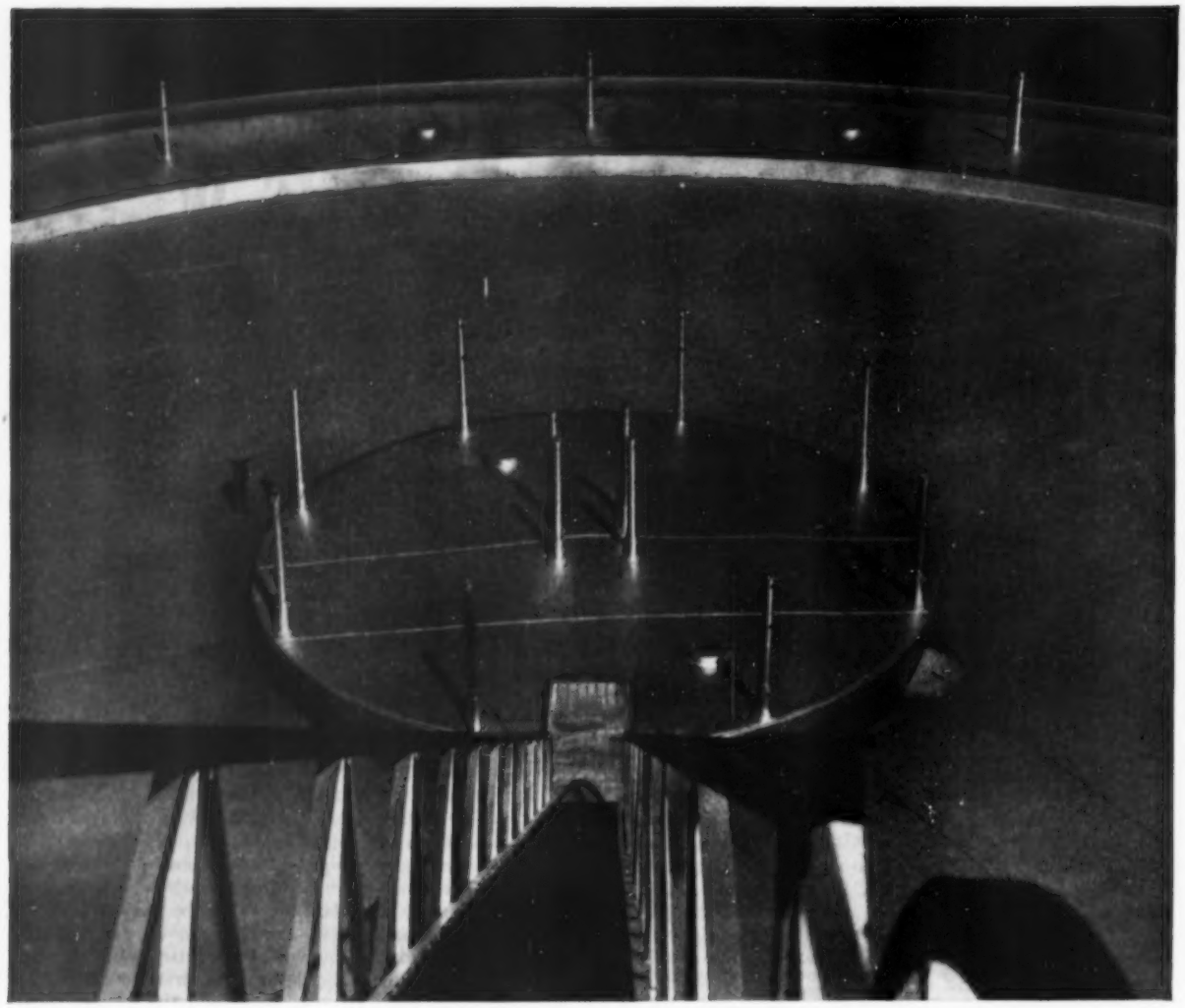
★ ★ ★

The Five-Year Heeby-Geebies. It seems to me that there comes a time in every technical man's career when, like the husband past 40, he gets the fidgets, the urge to stray from the fold. At about the five-year experience mark he reaches a turning point: he has sufficient experience to feel confident technically, he is been around long enough to pretty well see what lies ahead, he feels capable of handling a bigger job, and he realizes that he had better move before his roots get any deeper. *Why shouldn't technical managers recognize these five-year jitters and plan some morale-boosting prestige-heightening gestures to minimize the effects?*

★ ★ ★

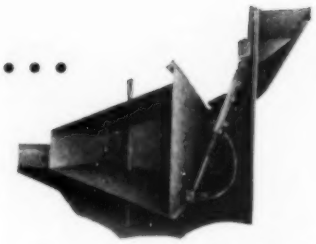
Keep Up With New Developments by giving your most careful attention each month to the two departments "What's New in Equipment" and "What's New in Manufacturers' Literature." It's quite a chore to pick the best selections from the bales and bales of material that flow in daily from manufacturers all over the world. A very capable young engineer on our staff combines his own industrial experience with frequent consultations with men in the industry to come up with the best possible choices. In every instance, the manufacturer is required to back up the story with printed information of his own since we can give so little space to each item. Under each little story you will notice a number. Just flip over to the tear-out prepaid postcard located inside the back cover, circle that number, and you get complete information in very short order.

—*Bob Phillips*



You are looking down...

into a Graver Center-Weighted "Floater." It's a well-built tank especially designed to conserve volatile vapors by means of Graver's own "Vapor-Stop" Seal—the improved seal which maintains firm closure between the floating roof and the shell. This patented Graver seal mechanism is an integral part of all Graver Floating Roof designs. It is flexible, yet firm—tight, yet responsive. It provides centering action for the roof and prevents the entrance of air and rain. From time to time you may expect similar technological improvements from Graver...where increasing emphasis will continue to be placed on research and development.



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The seal is free and limber, yet continues to close the gap and prevent loss of vapors. It is successful on both converted tank shells and new construction.

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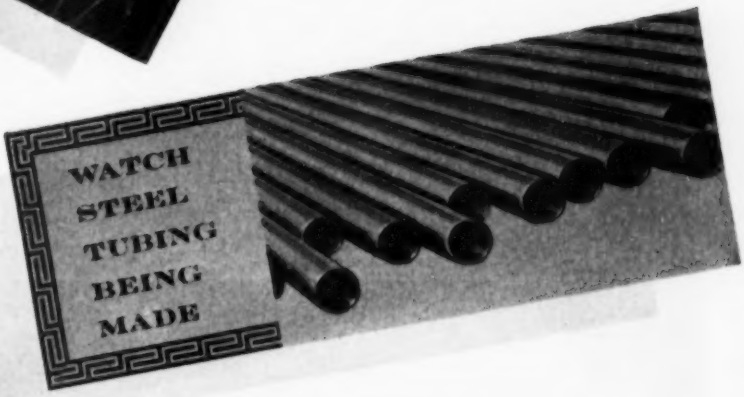

PATCO INVITES YOU TO THE MOVIES

A twenty minute, sound, color motion picture has just been released by Pacific Tube Company, of Los Angeles. The film is a pleasant interesting education in steel tubing manufacturing. Animation drawings clearly show the tube reducing and drawing operations. The largest drawbench in the West is shown in action.

This film can be made available to your company or organization without charge. Write to Film Department, Pacific Tube Company, 5710 Smithway Street, Los Angeles 22, California. Telephone Raymond 3-1331.

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2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6°°

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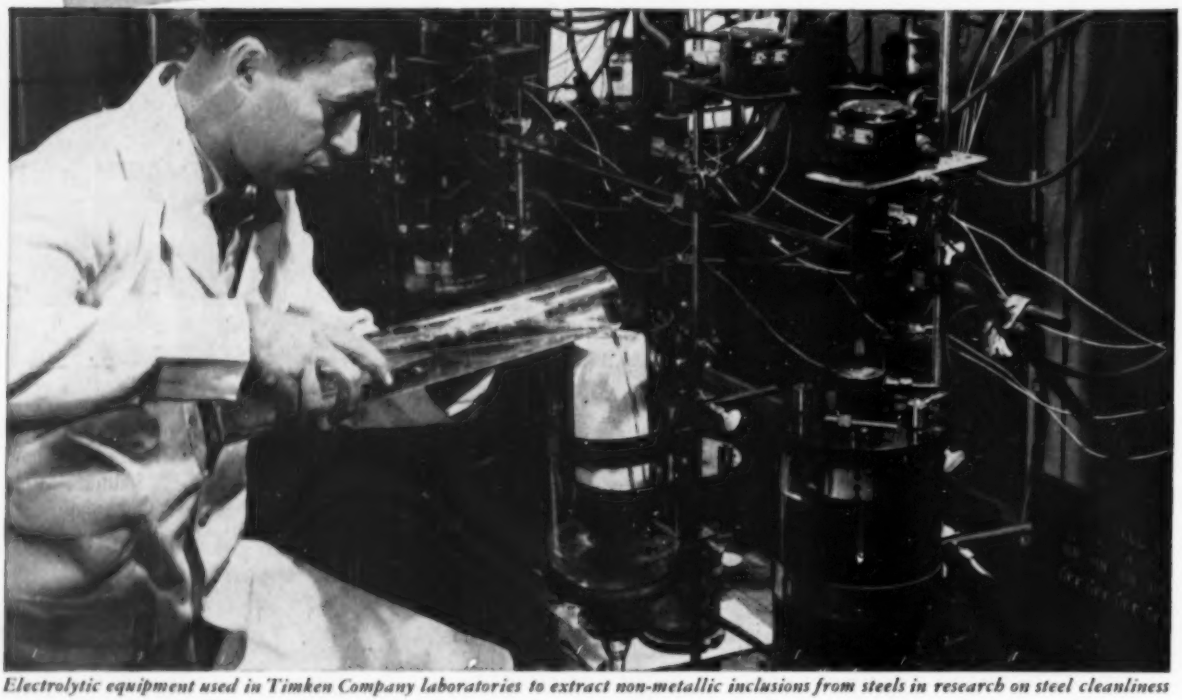
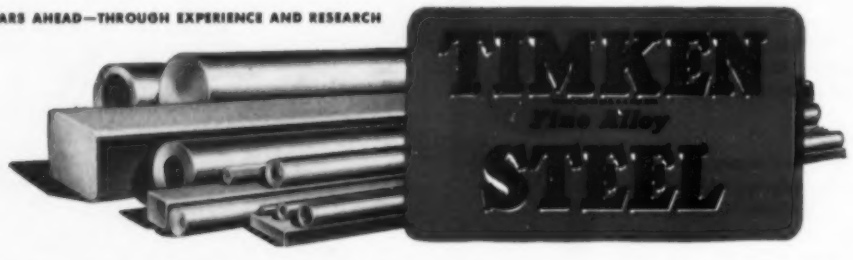


Electrolytic equipment used in Timken Company laboratories to extract non-metallic inclusions from steels in research on steel cleanliness

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



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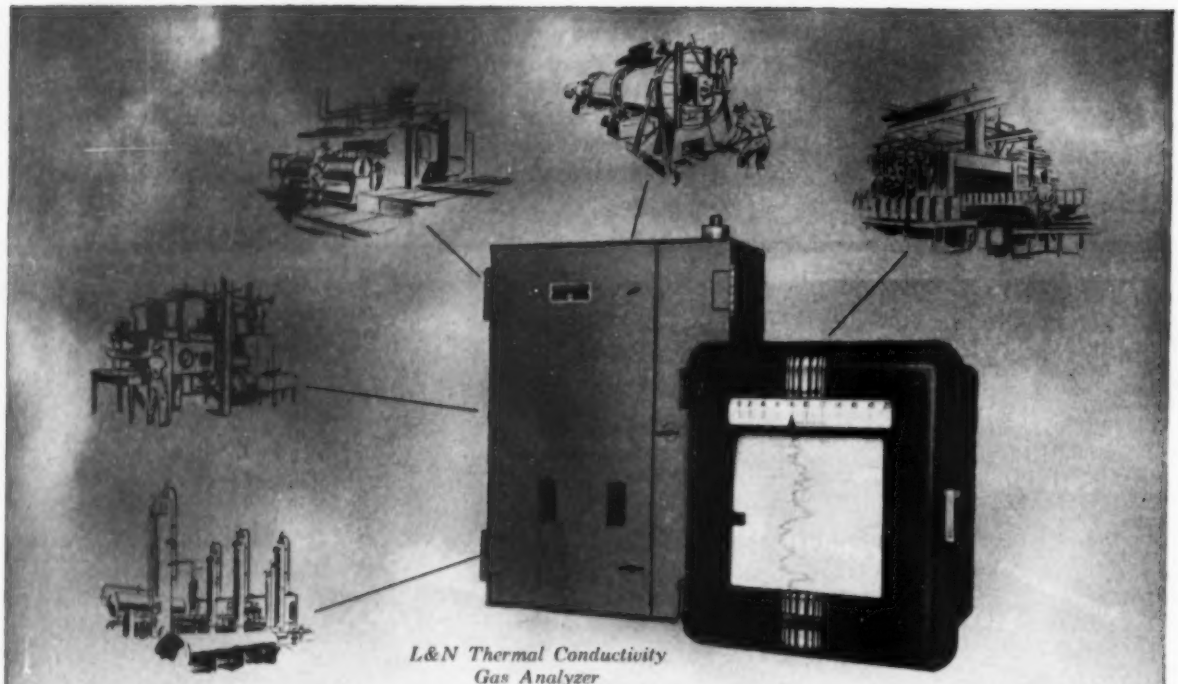
For more data on advertised products, use Readers' Service Cards, last page.



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Cells—All-glass construction prevents corrosion and consequent loss of calibration. All cells for a given gas and range of concentration are interchangeable. Cell assembly has no moving parts; requires no reagents for analysis.

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For Folder ND46-91(2), "Speedomax Gas Analysis Equipment," write to Leeds & Northrup Co., 4923 Stenton Ave., Philadelphia 44, Pa., or contact your nearest L&N field office.

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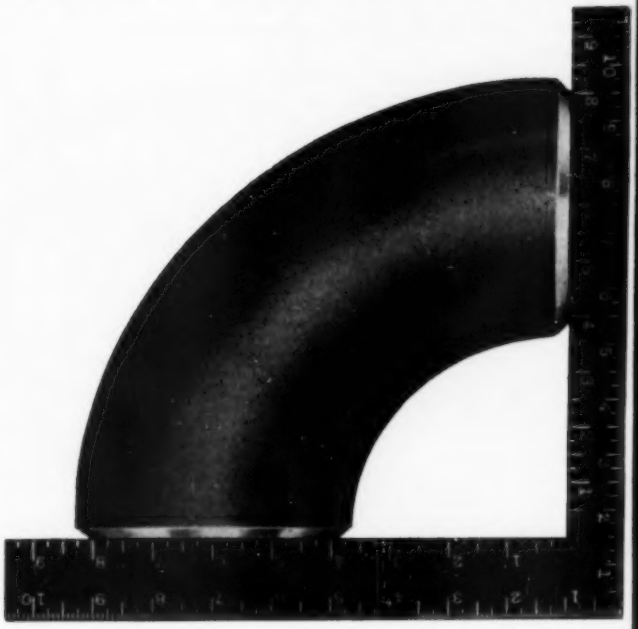

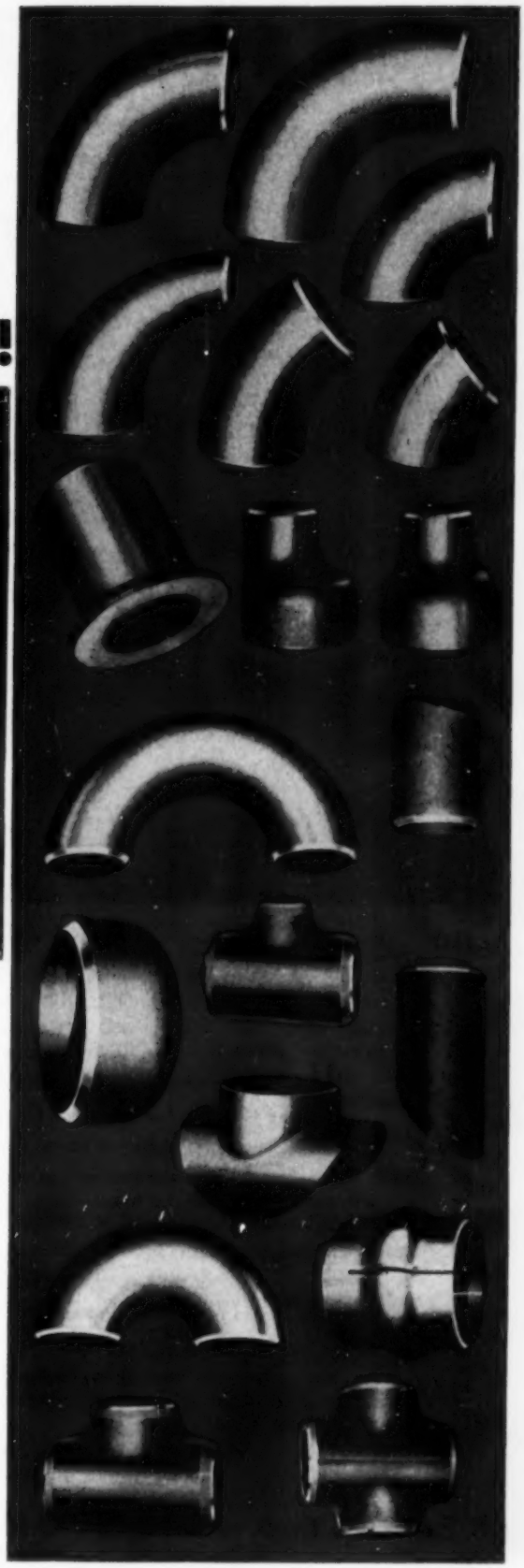

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Roofing and Siding Contractor: Standard Asbestos Manufacturing & Insulating Company, Kansas City, Mo.

Here is the plant of the Natural Gas Storage Company of Illinois, Herscher, Ill. "Century" Asbestos-Cement Corrugated is used for the roofing and siding.

"Century" Corrugated is made of two permanent, highly fire-resistant materials —asbestos fiber and portland cement— compressed under tremendous hydraulic pressure to make strong, tough sheets for almost every roofing or siding requirement. It can't burn, rot or corrode. What's more, it resists weather, vermin and insects. There's rarely a need for maintenance and it never needs protective paint. "Century" Corrugated Asbestos is low in first cost and low in application cost . . . easily sawed, drilled and fitted on the job.

Be sure to write us for information about particular applications. We'll rush a reply with complete details.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

K&M best in asbestos

For more data on advertised products, use Readers' Service Cards, last page.

PROCESS EQUIPMENT NEWS

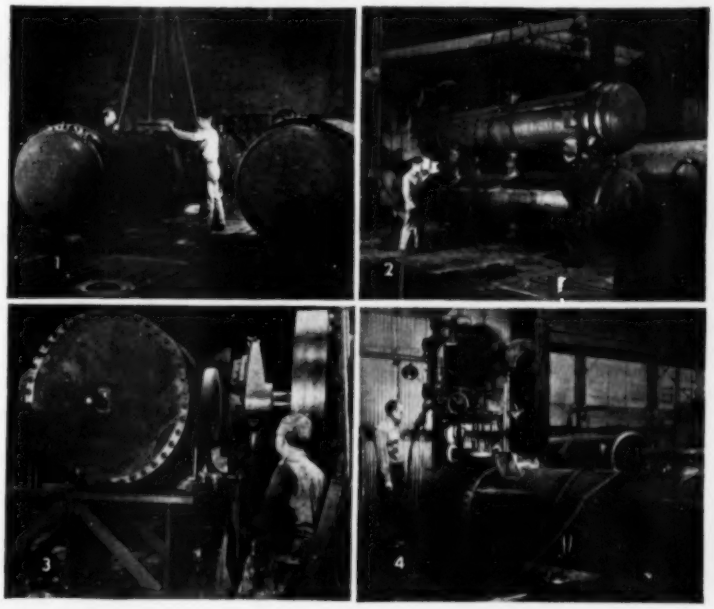
PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY AUGUST-SEPTEMBER 1954

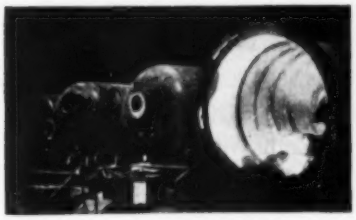
Five Giant Reactors For High Octane Gasoline Plant

In this impressive line-up in Kellogg's Jersey City, N. J., shops (below) are shown four of five identical pressure vessels currently being fabricated for a large Midwestern refiner of petroleum.

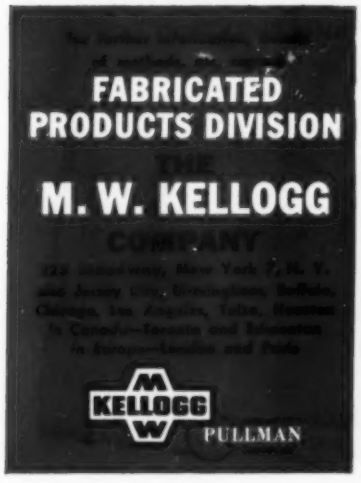
When completed, these giants will function as the reactors for a fixed bed catalytic reforming unit —a process that reforms low grade naphthas into high octane gasoline through the use of a platinum catalyst and high temperatures and pressures.

Each of the reactors is 9 feet in internal diameter by 10 feet





3 inches in length. To withstand internal operating conditions of more than 1000°F. and nearly 400 pounds pressure, they are constructed of carbon moly steel, 1-7/16 inches in thickness. When completed, each vessel will tip the scales at 39,000 pounds.



Extra Care in Stacking Exchangers Pays Off in Trouble-Free Operation

When an exchanger consists of two or more sections, with shell and tube fluids flowing in series, it is frequently possible to save space, piping, and supporting steel by stacking the units nozzle-to-nozzle. Kellogg, in the course of its 30 years experience in manufacturing exchanger equipment, has developed a number of special techniques for stacking units whenever this arrangement is called for which assure precise alignment of nozzles, easy assembly, and trouble-free operation.

The photographs above show a sequence in just one of the precautionary operations Kellogg uses to assure proper alignment of nozzles in two vertically stacked units. Normal manufacturing and assembly tolerances for nozzle locations, height of nozzles, and angular alignment have of course been taken into consideration in these sections.

At the start of the operation, both units have been inspected and tested hydraulically. With the shell and channel nozzles of one section left unmachined and undrilled, the two units are stacked in the shop (Photos 1 and 2). In this position, the top unit is leveled, supports are shimmed as required, and the nozzles are laid out for facing and drilling to match the nozzles of the lower one which were faced and drilled prior to welding into the unit.

After determining the alignment, machining requirements, and placement of flange holes on the unfinished section, it is taken down and set up in a boring mill (Photo 3) where the nozzle flanges are faced. In the final operation (Photo 4), flanges are drilled according to the layout determined while the units were stacked.

By following this careful procedure in the shop, Kellogg can assure perfect matching of the units when they reach the field. Final assembly is thus made easier, and chances of leaks, once the stacked exchangers are in operation, are reduced to a minimum.

"An Outstanding

FIRST ULTRAFORMER

On May 7th, 1954, the first Ultraforming unit in this country was completed by Lummus for Pan-Am Southern Corporation at El Dorado, Arkansas — only 204 days after construction began. The customer took over operation after only 20 days of initial run — accepted the installation as performing beyond expectation in every department.

The Ultraformer is designed to upgrade 7300 barrels per day of light fraction charge stock at 300 psig, producing gasoline in excess of 90 octane clear rating.

Pan-Am Southern had not believed it possible that the first unit of a new commercial process could be designed and built in so short a time. Their pleasure is expressed in this letter from Mr. R. T. Colquette, Vice-President. Lummus, too, is pleased to have served a good customer so well.

CAN WE HELP YOU WITH YOUR NEXT PROJECT?

The Lummus Company, 385 Madison Avenue, New York 17, N. Y. Engineering & Sales Offices: New York, Houston, Montreal, London, Paris. Sales Offices: Chicago, Caracas. Heat Exchanger Plant: Honesdale, Pa. Fabricated Piping Plant: East Chicago, Indiana.

For more data on advertised products, use Readers' Service Cards, last page.

Record-Breaking Performance"

COMPLETED IN 204 DAYS!

PAN-AM SOUTHERN CORPORATION

PRODUCES AND PURCHASES, TRANSPORTS, REFINES AND MARKETS PETROLEUM

R. T. COLQUETTE
Vice-President

P. O. Box 2—New Orleans 6, Louisiana

June 14, 1954

Mr. C. A. Barrere
Vice President
The Lummus Company
2707 Weslayan Road
Houston, Texas

Dear Mr. Barrere:

Recognition of an outstanding record-breaking performance is always a pleasant duty.

The construction and completion of our 7300 barrels per day El Dorado Refinery Ultraformer by your company has been a remarkable achievement. On July 9, 1953, we authorized you, under letter of intent, to proceed with the engineering and purchasing of these facilities. On November 5, 1953, a construction contract was signed to construct the unit with certain bonus-penalty provisions for initial operations by July 7, 1954. At the time of our signing the contract, we did not think it physically possible for you to erect and start initial operations of the first unit of a new commercial process in 200 days. However, we were pleased to pay you 46 days bonus payment when you placed these facilities in operation on May 24, 1954.

After 20 days of continuous operation the unit has demonstrated completely satisfactory operability under the provisions of our contract, and this letter will serve official notice to you that as of this date we are taking over operation of this unit -- subject, of course, to the usual continuing guarantees of materials and equipment.

Please extend our sincere compliments to all of the members of your organization who worked on this project for a Job exceptionally well done.

Yours very truly,

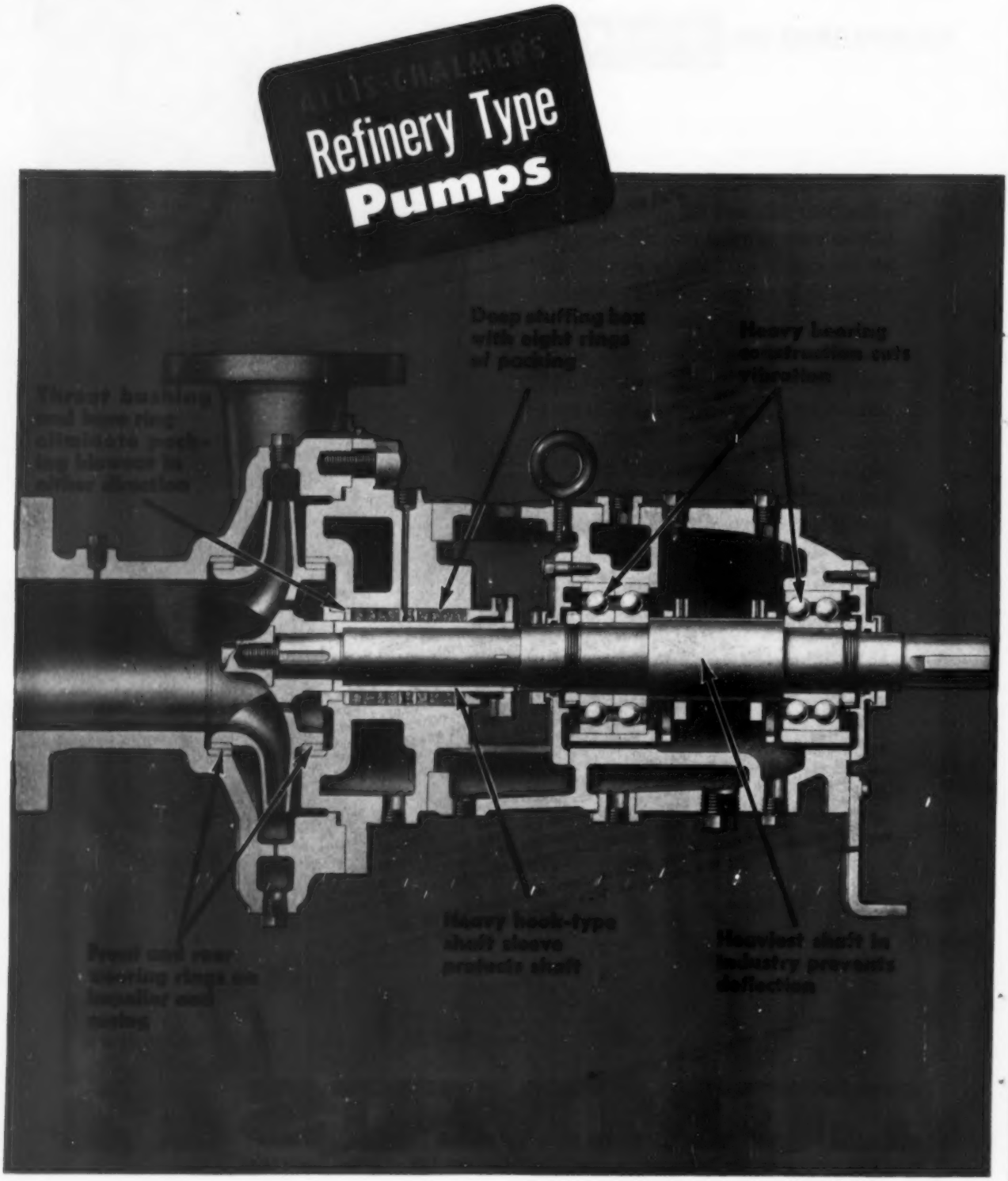
R. T. Colquette

LUMMUS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

For more data on advertised products, use Readers' Service Cards, last page.

EXTRA heavy-duty construction


ALLIS-CHALMERS
Refinery Type
Pumps
Deep stuffing box with eight rings of packing
Heavy bearing construction cuts vibration
Heavy hook-type shaft sleeve protects shaft
Heaviest shaft in industry prevents deflection

For more data on advertised products, use Readers' Service Cards, last page.

gives you

service continuity

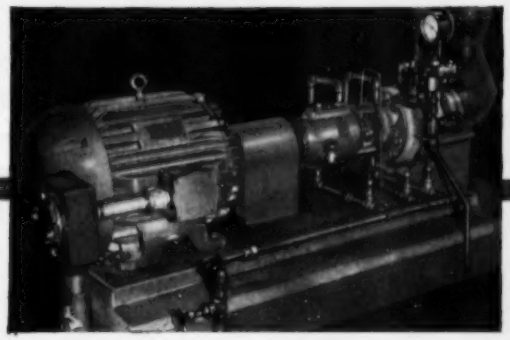
WHERE A STOPPAGE COSTS A FORTUNE, install Allis-Chalmers Refinery Pumps. These pumps have the stamina to keep going on the toughest applications for years without rest. Every construction detail, those shown here and many others, has been carefully engineered to provide ample reserves of strength and durability. Careful workmanship and expert application engineering make these pumps deliver all the reliability that is designed into them.

Wide Choice of Materials, Features

The Allis-Chalmers Refinery Pump can be fitted to suit your requirements exactly. Practically any material normally used in pumps may be specified. Stuffing box takes packing, mechanical seal or both. Cooling water or oil may be used in five separate places so you can select exactly the cooling arrangement for your particular needs. Suction may be at top or on end.

Get Complete Information and Engineering Help

Your nearby Allis-Chalmers representative will be glad to help you with your refinery pump problems. Or write for Bulletin 52B7775. Allis-Chalmers, Milwaukee 1, Wisconsin.

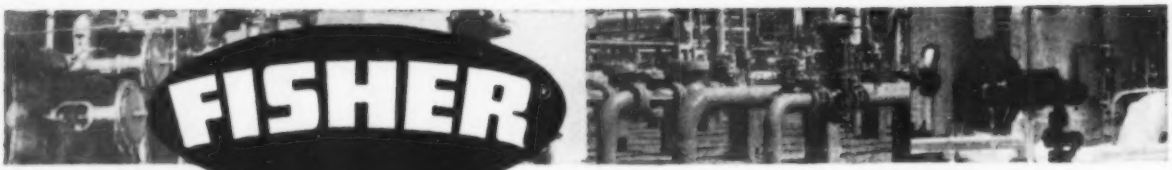


Save Engineering and Installation Time with an Allis-Chalmers Pump Package

Allis-Chalmers will supply a complete pumping unit — pump, motor and control — engineered to work together and with pump and motor mounted on a single base plate ready for installation. You save engineering time because you don't have to match components from different manufacturers. You save installation time because the unit comes to you already assembled. And, most important, you are sure that the components will work together to give you long life at low operating cost. The complete unit is covered by a single guarantee backed by Allis-Chalmers well-known customer satisfaction policy.

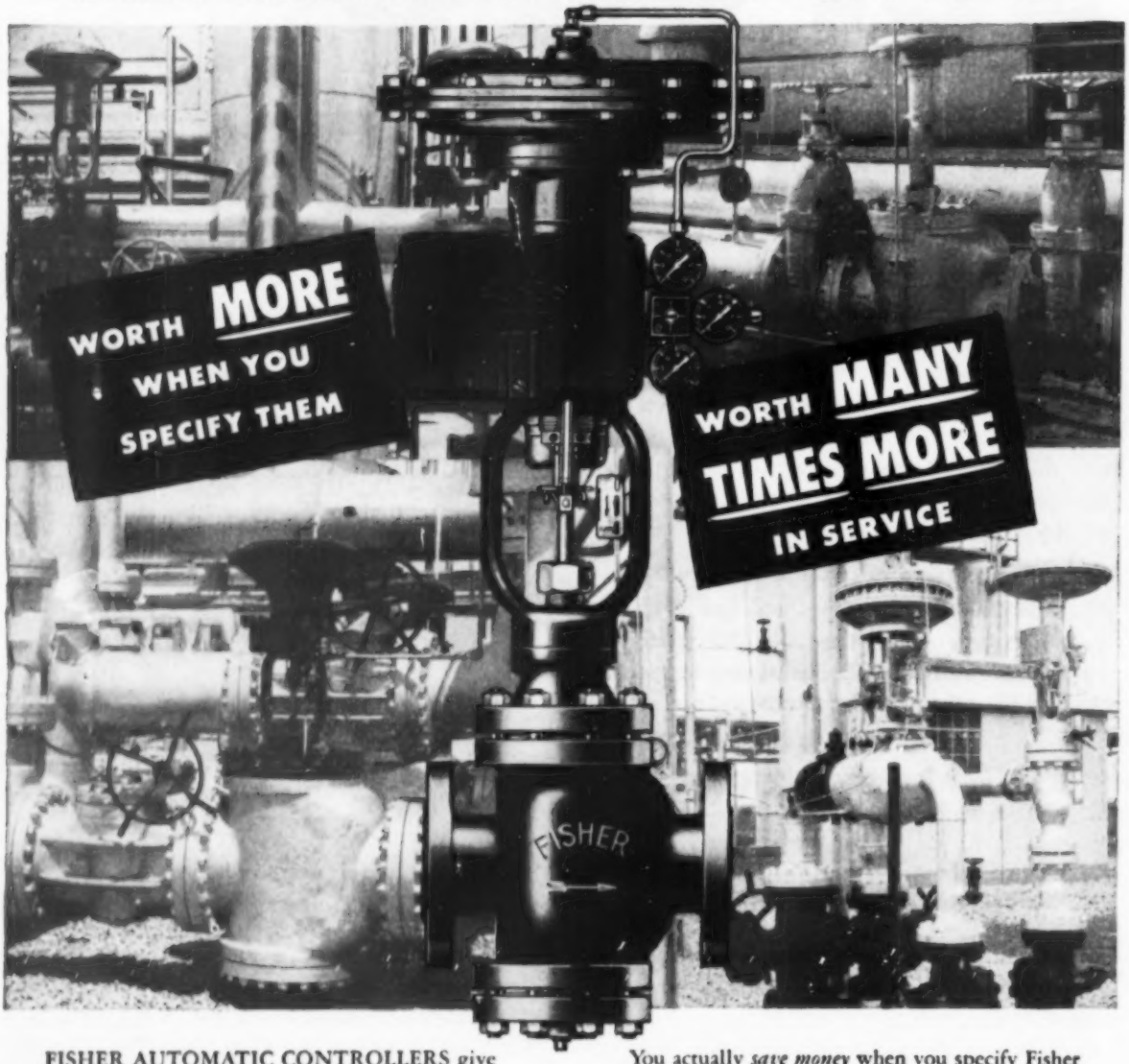
A-4333

ALLIS-CHALMERS A-C ALLIS CHALMERS



FISHER

Automatic Controllers



FISHER AUTOMATIC CONTROLLERS give you *more for your money* because they *stay on the job*—minimizing "out-of-service" production expenses that quickly amount to many, many times the cost of the controller.

You actually *save money* when you specify Fisher Pressure Regulators—Pump Governors—Liquid Level Controllers—Pilot Operated Regulators—Lever and Float Valves—Intermitters—Gas Regulators—Valve Positioners.

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

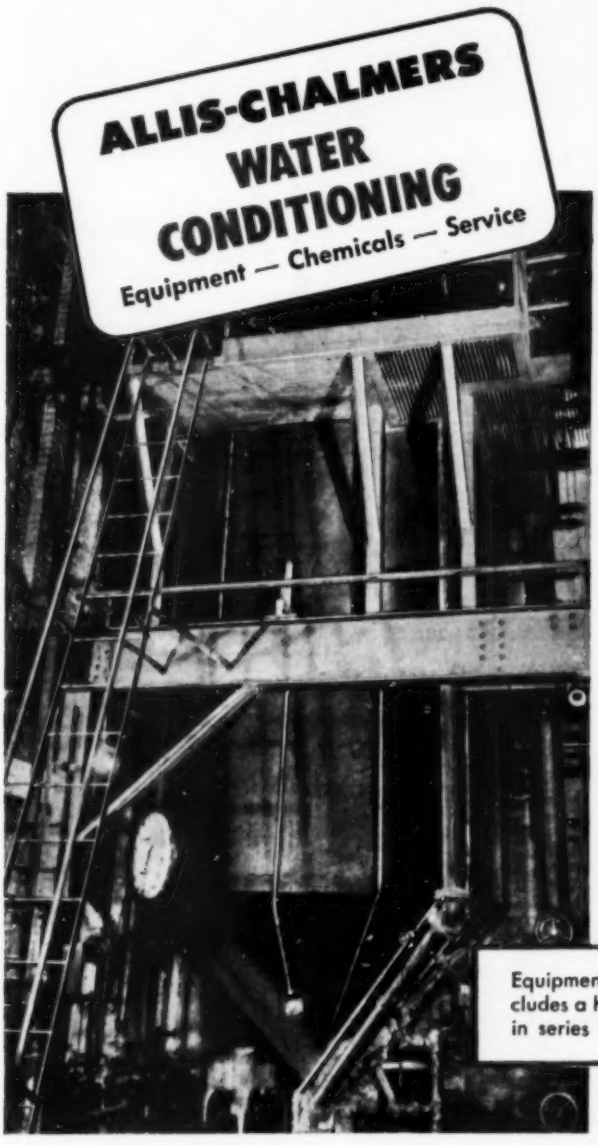
WORLD LEADER IN RESEARCH FOR
BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER
Since 1880

For more data on advertised products, use Readers' Service Cards, last page.

Minneapolis Gas Co., Minneapolis, Minn., Gets...

MORE BOILER FEEDWATER



How to increase feedwater supply without adding excessively to chemical and equipment costs? That was the problem at Minneapolis Gas Company, Minneapolis, Minn., when installation of new equipment increased demands on the power plant.

Allis-Chalmers water conditioning engineers solved this problem with a hot lime, ion exchange system that provides zero hardness, extremely low silica content, low alkalinity and low CO_2 in steam. Chemical costs are very reasonable, since only salt and lime are needed. An added dividend can come from the small amount of space required for equipment — for example, in one installation of this type, the resin tanks are tucked under the basement stairs.

Solve Any Water Problem

You can find a solution to any water conditioning problem by consulting with an Allis-Chalmers water conditioning expert. Allis-Chalmers will provide analysis and a complete recommendation, in addition to supplying you with the chemicals and equipment you need.

If you would like to learn more about the hot lime, ion exchange process outlined above, get a copy of Allis-Chalmers Water Conditioning Informational Bulletin 49 from your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4403

Equipment similar to this at Minneapolis Gas Co. includes a hot process lime-soda softener which is placed in series with the hot zeolite (ion exchange) unit.

ALLIS-CHALMERS A-C ALLIS-CHALMERS

For more data on advertised products, use Readers' Service Cards, last page.

HERE'S HOW ONE REFINER SAVED WITH A LJUNGSTROM

COMPARATIVE FUEL AND POWER COSTS

	WITH AIR HEATER	WITHOUT AIR HEATER
Heat absorption /hr millions of BTU	100	100
Oil—inlet temp.—°F	700	700
Flue gas temp. to stack—°F	400	950
CO_2 to stack—%	10.0	11.0
O_2 to stack—%	5.2	3.7
EFF (assuming 5% radiation loss)—%	78.5	66.0
Millions of BTU required/hr	127.39	151.52
Annual cost of fuel ($2.50/Bbl—8000 hrs)	$392,000	$466,200
Kilowatt-hours	80	
Annual cost of energy @ 1¢/kwh—8000 hrs	$6,400	
Annual operating cost—fuel and energy—8000 hrs	$398,400	$466,200
Annual fuel savings	$74,200	
Annual net savings in operating costs (fuel savings less energy costs)	$67,800	

Wherever you burn fuel, you need LJUNGSTROM

Listed in this table are comparative fuel and power costs for operating two identical deFlorez stills, one with and one without a Ljungstrom® Air Preheater. Operating costs *without* the Ljungstrom reflect performance with a convection bank of tubes.

Remember: the initial cost of a Ljungstrom installation often is more than offset by the savings reflected in eliminating the convection bank.

Remember, too — operating savings are only part of the story. Higher flame temperatures developed through the use of preheat increases heat transfer to oil tubes — thereby increasing throughput.

The Air Preheater Corporation 60 East 42nd St., New York 17, N. Y.

Now, for your convenience the NAME of each GRADE of Aerocat Fluid Cracking Catalyst indicates its PDI

* **Particle Distribution Index**
Key to Catalyst Efficiency

These three new grades of AEROCAT Fluid Cracking Catalyst, each identified by its PDI (the amount of catalyst in the 30-80 micron range), cover all fluid cracking unit requirements:

Aerocat 50/60 (Light) — for fluid units with low linear gas velocities, adequate dust disengaging space, excellent cyclone and Cottrell efficiency, low bed density needs.

Aerocat 60/70 (Intermediate) — for fluid units with moderate to high linear gas velocities, adequate catalyst recovery.

Aerocat 75/85 (Narrow) — for fluid units with high linear gas velocities, moderate disengaging space, limited recovery equipment.

Technical Data Sheet — "AEROCAT — Particle Size Distribution" — available on request.

As the result of a survey of the industry's cracking catalyst needs, Cyanamid has recently made available three new grades of AEROCAT fluid catalysts. Particle size distribution of each grade has been designed to offer optimum catalyst utilization under the entire range of existing fluid unit operating conditions.

Because of the importance of Particle Distribution Index in selecting the correct catalyst, we have gone a step further for your convenience. We have indicated the PDI in the *name* of each of these three grades of AEROCAT, as shown in the box.

For details, send for a new technical data sheet on the Particle Size Distribution of AEROCAT or discuss the subject with your Cyanamid Representative.

The convenience offered by this grading system is only one among many reasons why *8 out of 10 users of synthetic catalyst prefer* AEROCAT — and Cyanamid's service.

They also find AEROCAT the surest, most economical means for securing

- high octane yields
- high throughput
- low CO_2/CO ratio in flue gas
- high isobutane yield
- excellent heat, steam, sulfur stability

Aerocat® Fluid Cracking Catalyst

AMERICAN Cyanamid COMPANY
REFINERY CHEMICALS DEPARTMENT
30 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

For more data on advertised products, use Readers' Service Cards, last page.

NOW

you can operate small valves economically & safely

with Limitorque® REMOTE CONTROL

The new SMA-00 and SMA-000 LimiTorque Valve Control is the latest and most advanced method of operating small valves, ranging from 1½" up to 8" in diameter. These units provide complete safety to workmen, by eliminating the need of climbing to high or hazardous locations for manual valve operation. The valve operating parts are protected by two limit switches ...One provides uniform valve seating thrust, giving positive protection to the parts from overload. The second switch is the geared limit, which controls the stem travel for both directions.

SMA-00 and SMA-000 LimiTorque Valve Controls offer an extremely economical, and simple method of motorizing smaller valves. These Operators can be readily applied to all types of Valves: Gate, Globe, Plug and Butterfly . . . and may be had to actuate by a wide range of power sources including Electricity, Hydraulic Pressure, Natural Gas or Air.

For full details and information regarding these new LimiTorque Valve Controls, write for latest Bulletin.

PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

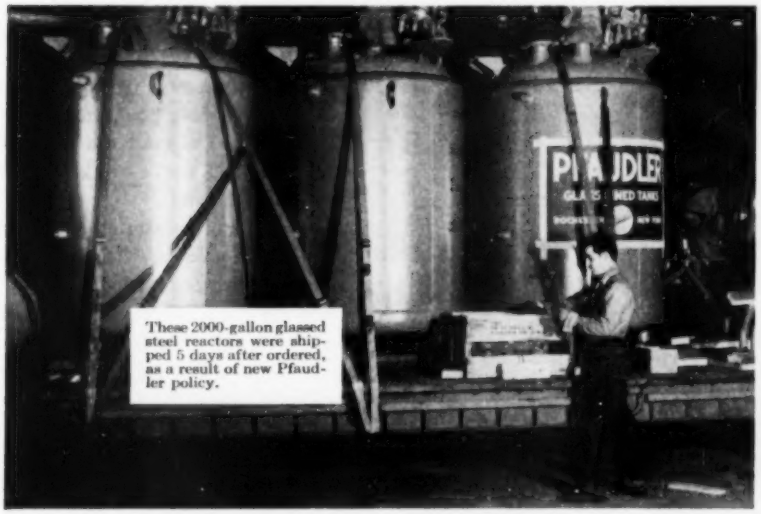
Industrial Gears & Speed Reducers

LimiTorque Valve Controls

Corrosioneering News

Quick facts about the services and equipment Pfaudler offers to help you reduce corrosion and processing cost.

Published by The Pfaudler Co., Rochester 3, N.Y.



These 2000-gallon glassed steel reactors were shipped 5 days after ordered, as a result of new Pfaudler policy.

You get a blotter . . . we'll get a packing case

New Fabrication Policy Speeds Equipment

Almost before the ink dries on their purchase order, many chemical processors have been surprised recently to learn that their new Pfaudler equipment would be delivered in a few days.

A new policy of manufacture, emphasizing standard design, makes this possible. This policy is revolutionary in the process equipment industry, and results from Pfaudler's 70 years' experience in supplying glassed steel and alloy equipment to processors. By carefully noting which features are most often required, they have incorporated many "custom" features in standard designs, thus providing maximum flexibility of equipment, with faster delivery.

You can take advantage of off-the-shelf deliveries of glassed steel or alloy reactors, columns, heat exchangers and other equipment by discussing your problem with the Pfaudler representative. Let him recommend, where possible, the *standard* Pfaudler units that incorporate the features you need.

Many of these units are in stock now, waiting to be shipped to you. Call in your Pfaudler sales engineer today and let him help you save time and money.

The Bonnet that Heads Off Corrosion!

Corrosion-proof Hastelloy and glassed steel join forces to resist severe acid attack

Handling pure monochloro acetic acid free of low-boiling acid chlorides requires a heat exchanger that shrugs off relentless corrosive action. To meet this need, New York-Ohio Chemical Co., a subsidiary of Stauffer Chemical Co., turned to Pfaudler corrosioneering.

The answer: Hastelloy "C" for the tubes, and glassed steel for the bonnets, or headers. This combination cuts down on expense as well as corrosion. By using costly Hastelloy only where absolutely necessary, and taking advantage of the less expensive corrosion resistance of glass plus the working strength of steel, substantial savings were made.

To solve problems such as this, Pfaudler corrosioneers enjoy complete freedom in selecting materials. With *every* type of alloy, from stainless steel to titanium, at their disposal they can give you exactly what your process requires. And, when practical, they can also call upon famous Pfaudler high-acid resisting glassed steel.

For an unbiased recommendation on your corrosion equipment problem, talk it over with your Pfaudler representative. Or check the corner card for further information.

How Lederle Keeps Pharmaceuticals Pure

When you've got to cram highly concentrated vitamins or drugs into a tiny pill no larger than your shirt button, you just don't have room for product contamination.

Lederle Laboratories Division of American Cyanamid puts the hex on contamination, at its Pearl River, N. Y. research and manufacturing center, with the two-fisted corrosion resistance of glass combined with the structural strength of steel.

In Pfaudler glassed steel, they found the perfect pilot plant equipment for scale-up from laboratory apparatus. Using 10 Pfaudler glassed steel reactors of various sizes, they have an economical chemical plant that licks corrosion before it starts. Product purity is safeguarded from start to finish of each process.

From pilot plant to full-scale operation, glassed steel reactors provide the corrosion resistance that assures product purity at Lederle's Pearl River plant.

If you have a problem of product contamination, you may get an easy answer by checking the corner card below and mailing it to Pfaudler.

THE PFAUDLER CO., Rochester 3, N.Y.

Please send more information on:

- ☐ Immediate delivery of glassed steel equipment
- ☐ Corrosion materials for_____process
- ☐ Glassed steel for processing_____

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE___ STATE___

WHAT'S NEW AT BRISTOL...

SIMPLICITY? Look inside!

Remove the cover from the new Bristol Metagraphic pneumatic transmitter. You see at once the inherent simplicity of Bristol's world-famous measuring element.

These Bristol measuring elements have chalked up as much as 35 years' continuous service without attention.

The Metagraphic transmitter sets new standards of accuracy and reliability in measuring and transmitting readings of temperature, pressure, vacuum, differential pressure and liquid level. Here are some of its features:

NON-BLEED BOOSTER PILOT for low air consumption. In balanced position, air consumption is only 0.07 scfm.

HIGH-SPEED TRANSMISSION and superior control result from large air capacity of the pneumatic relay – 3.0 scfm.

INDICATING DIAL GAUGE to show output pressure can be screwed into front of transmitter. No piping or fittings are needed.

Get the whole story on the Metagraphic transmitters. Write for free bulletin A105 to The Bristol Company, 111 Bristol Road, Waterbury 20, Connecticut.

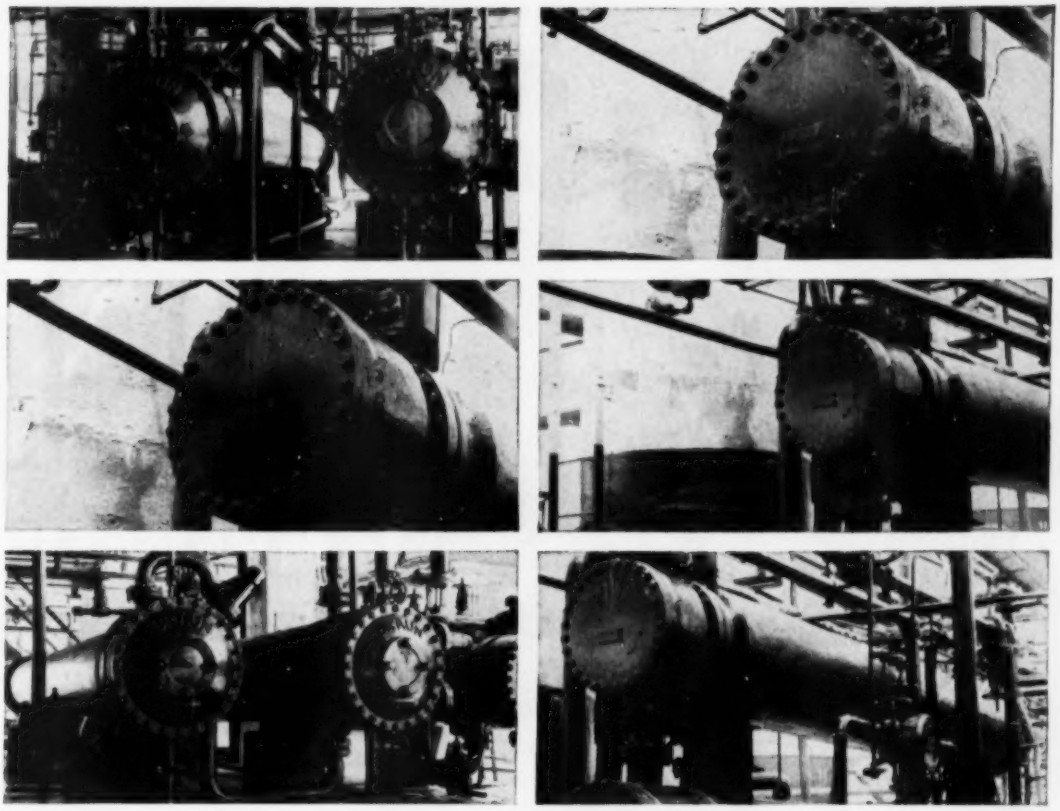
FRICTIONLESS METAGRAPHIC TRANSMITTER has only one pivot, no flexures. It's sensitive to extremely small changes in the measured quantity (as minute as 0.03% of range, including reversal). You can get the Metagraphic in a wide selection of ranges, with magnified ranges available and over-range protection standard.

4.24

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



CROWN

Central Petroleum Corporation Uses

ELECTRUNITE HEAT EXCHANGER TUBES

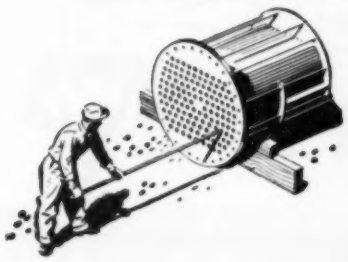
Like many other leading refiners, Crown Central has the problem of pressure coupled with high temperature and tough corrosive conditions. And this drastically affects tube life.

In severe service like this, Republic ELECTRUNITE Tubing has advantages which result in extended tube life. Normalizing, done in the latest type controlled reducing atmosphere furnaces, relieves stresses, improves grain structure and ductility. There is no oxidation. No scale forms.

Installation costs are often lower, too. Uniform diameter means tubes slide in easily and quickly through holes in drums or headers. These ductile tubes expand easily with less danger of over- or under-rolling.

You can have all of these advantages in your heat exchanger tubes. Just specify Republic ELECTRUNITE Heat Exchanger Tubes on new equipment, or retubing. For more information, write to:

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
220 East 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.



Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

For more data on advertised products, use Readers' Service Cards, last page.

at high TEMPERATURE

Cylinder-Operated
by Remote Control

- **CATALYTIC CRACKING**
- **FLUID HYDROFORMING**

Wedgeplug Valves have an enviable record for handling extremely hot oils—hot catalysts—hot gases —and hot slurry.

Wedgeplug Valves made of Carbon Steel are recommended for temperatures up to 1000° F. When special metals are used, up to 1500° F.

The tapered plug lifts, turns, and re-seats in one operation. The raised seats are protected in both the open and closed position.

WEDGEPLUG
STEEL DRY PLUG VALVES

Opening and closing time of the remote control, cylinder-operated valve illustrated can be adjusted to suit varied service conditions.

Can be supplied: wrench-operated; handwheel-operated; worm gear-operated. Adapted for remote control thru use of electric, air motor, or air cylinder operator.

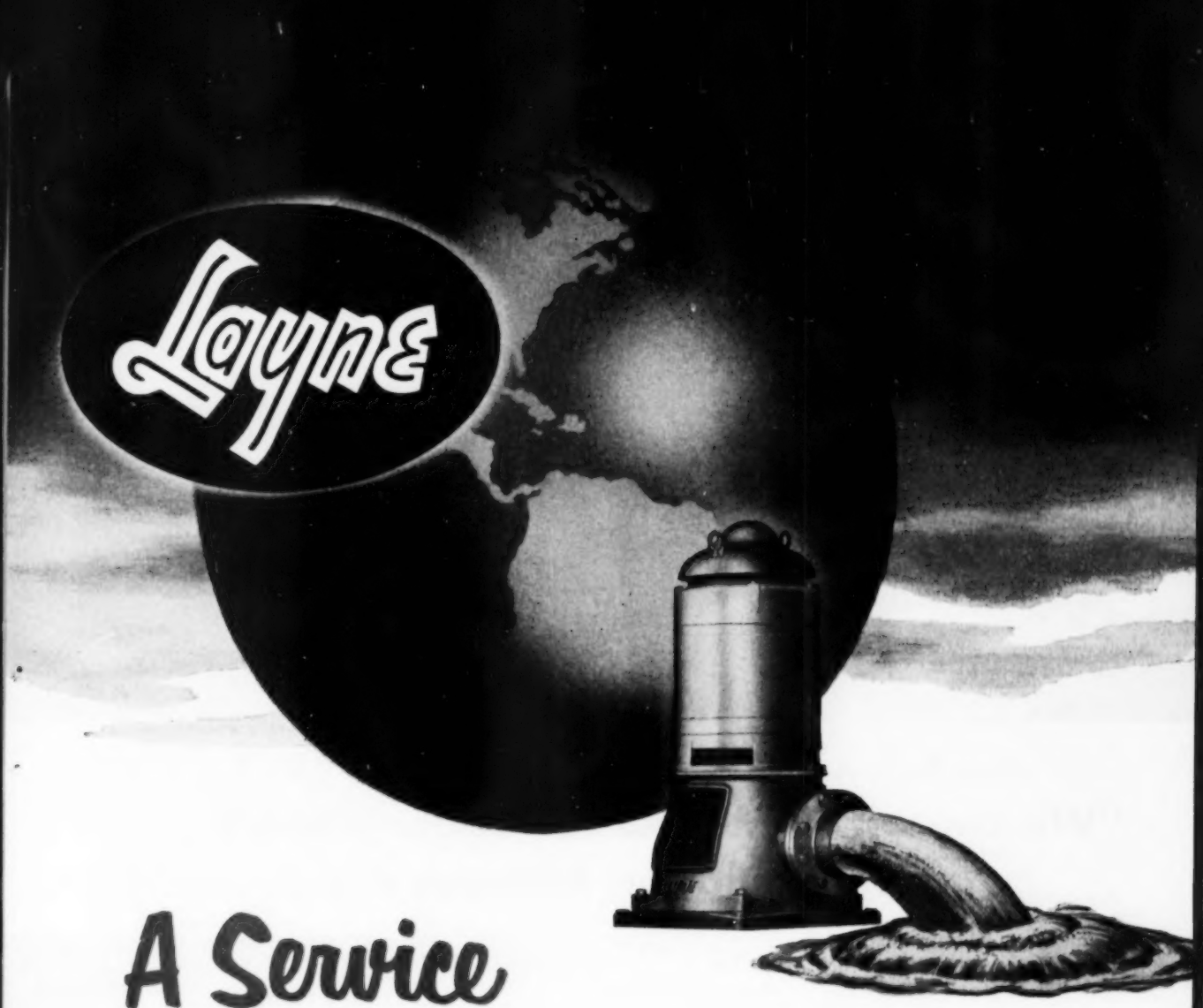
WEDGEPLUG VALVE COMPANY, INC.
NEW ORLEANS 15, LA.

An Affiliate of

STOCKHAM VALVES & FITTINGS
GENERAL OFFICES AND PLANT • BIRMINGHAM 2, ALA.

Warehouse Stocks and Sales Services Strategically Located

DESIGN ELIMINATES NEED FOR LUBRICATION



A Service

that knows no boundaries

From Alaska to Zamboanga and points North, East, South and West, wherever man has a need for water—there you will find Layne.

It's a typical American success story—this history that spans nearly three quarters of a century and started with a one man muscle power drilling rig—and an idea.

Today Layne is the name of a product—but it's more than that—much more. The name Layne is also the name of a service, international in scope, that includes every phase of ground water development from preliminary exploration to maintenance of installed equipment.

Where industry—agriculture—municipality—has any problem that relates to water, there is one organization that offers unbiased authoritative advice—plus the "know how" to solve the problem and keep it solved.

For information on any phase of ground water development, modernization, maintenance or equipment consult your nearest Layne Associate Company—or write

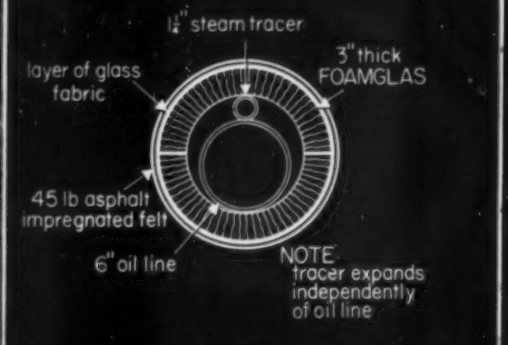
LAYNE & BOWLER, INC.
Memphis 8, Tennessee, U.S.A.

Layne Associate Companies Throughout the World

Layne

■ An informative booklet "Bulletin No. 100" will be sent free upon request.

Water Wells • Vertical Turbine Pumps • Water Treatment


½" steam tracer
3" thick FOAMGLAS
layer of glass fabric
45 lb asphalt impregnated felt
6" oil line
NOTE tracer expands independently of oil line

Con Edison engineers report:

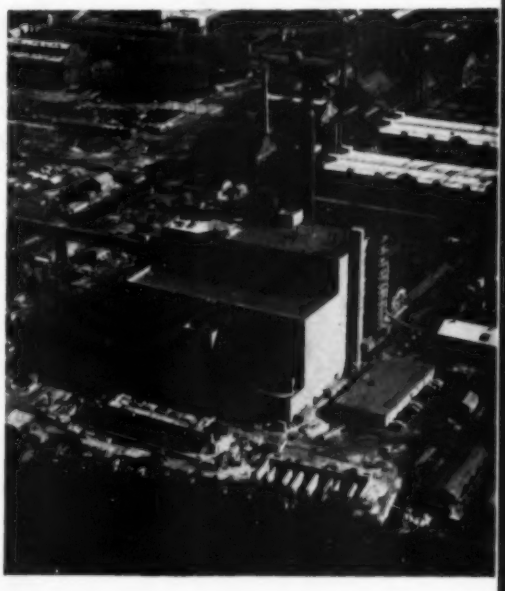
"We chose FOAMGLAS for underground pipe insulation because it stays dry!"

Consolidated Edison Company's engineers are using waterproof FOAMGLAS to insulate underground heated fuel oil lines at their Astoria, N.Y., Generating Plant. They report: "In this underground installation, our first concern was to get an insulation which would resist moisture and give consistent insulating results under damp conditions. We chose FOAMGLAS because of its moisture resistant qualities."

Con Edison's engineers continue: "Our choice of FOAMGLAS involved maintenance considerations, too. Replacing or servicing insulation in our underground installation would involve considerable expense. We feel that FOAMGLAS will help us hold maintenance expense to a minimum."

It makes sense . . . if Con Edison can achieve such benefits from FOAMGLAS under difficult operating conditions, *you* can profit by using this unique, *cellular glass* insulation. FOAMGLAS laughs at the moisture that cuts efficiency of other insulations . . . and is fireproof and acid-proof, too.

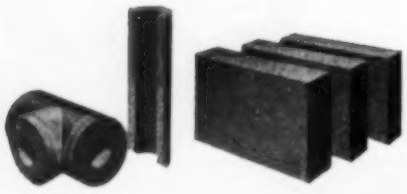
See our catalog in Sweet's Catalog Files . . . or send today for your sample and our booklets describing the use of cellular, *stay-dry* FOAMGLAS to insulate piping, tanks, and other equipment.



PITTSBURGH CORNING CORPORATION
Dept. Z-84, One Gateway Center • Pittsburgh 22, Pa.

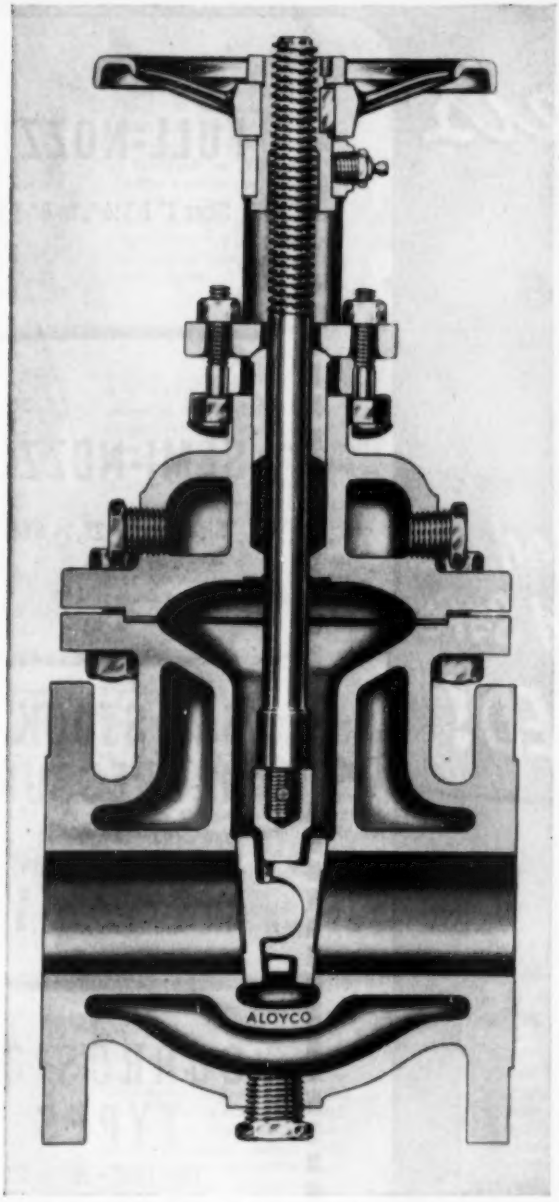
FOAMGLAS®

the cellular, stay-dry insulation



PITTSBURGH PC CORNING

Pittsburgh Corning also makes PC Glass Blocks



Cross-section shows how jackets extend to edge of flanges and include stuffing boxes on this Aloyco 1105 Jacketed Gate Valve. Also shown are the non-fouling, ball-and-socket split-wedge disc and mar-proof rocker-type gland plate and follower.

Now-

fully jacketed valves put the heat on slow-moving corrosives

Does your plant handle corrosive fluids that slow down or solidify under normal temperatures?

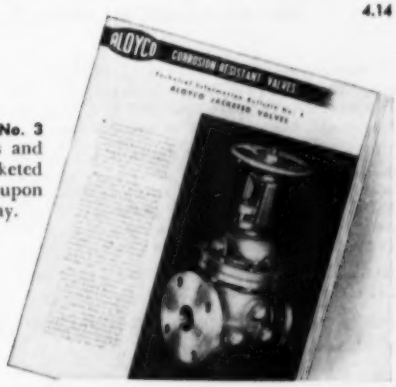
Then you're in line to benefit from the heat-holding design of Aloyco jacketed Gate, Globe and Check valves. Besides having all the Aloyco features shown at left, they're the only high alloy valves on the market to be *completely jacketed.*

They keep valves at higher temperature than steam tracing systems, and provide more uniform, less hazardous heating than thermal electric methods. You'll find them especially useful in line processing of rosin, resins, tars or tar oils, pthalic or maleic anhydrides, molten sulphur and other viscous liquids.

We'll be glad to arrange for a trial installation of Aloyco jacketed valves in your plant. Write the Aloyco Corrosion Engineering Service for further information. **Alloy Steel Products Company, Inc., 1301 West Elizabeth Ave., Linden, N.J.**

4.14

Fact-filled Bulletin No. 3 lists specifications and uses of Aloyco Jacketed Valves. Send coupon for your copy today.



25TH ANNIVERSARY

Longer Lasting

ALOYCO

VALVES

1ST IN CORROSIVE SERVICE

ALLOY STEEL PRODUCTS COMPANY, INC.
1301 West Elizabeth Avenue
Linden, New Jersey

Gentlemen:

I am interested in Aloyco jacketed valves. Please send me a free copy of your Bulletin No. 3.

Name_____

Firm_____

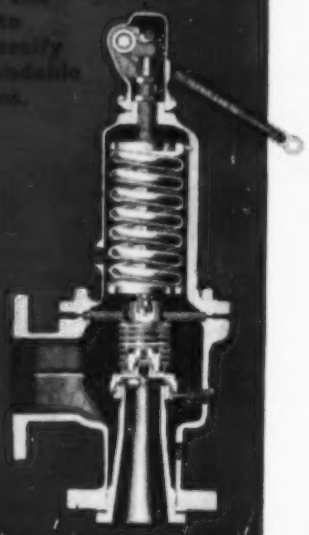
Address_____

City_____ Zone____ State_____

Farris

Modern design.... Accepted for dependability... Certified Safe

REALISTICALLY PRICED!



FULL-NOZZLE

Sizes 1" D 1½", to 8" T 10"

SEMI-NOZZLE

Sizes 1½" F 2", to 6" S 8"

BAR STOCK & HI-PRESSURE

Type 2745—½", ¾", 1"
Type 2740—½" x 1", ¾" x 1", 1" x 1", 1" x 1½"
Type 1430—1¼", 1½", 2"

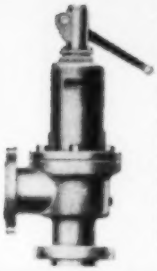
CORROSION TYPES

Type 1000—½" to 2"
Type 3725—½" to 1"
Type 3775—1½" to 2"

GENERAL SERVICES

Sizes ½" to 6" x 8"

Farris



TYPE 2680

Made in Series 30, 60, 90 and 150 inlet flanges, R.F. and R.T.J. Series 15 outlet standard. Available with "FarriSeal" or "BalanSeal" bellows—with or without internal heat exchanger coil; stainless steel, Monel and Hastelloy trim. Plain or packed cap, and open lever types.

TYPE 2610

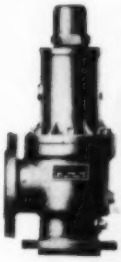
Made in Series 15 and 30 inlet flanges. Series 15 outlet standard. Parts interchangeable with heavy series valves. Full capacity, economical, for medium pressure range.

TYPES 2575 to 2578— Series A, B, C

A.S.M.E.—N.B. Steam Generator Safety Valve. Complies with A.S.M.E. Code for fired pressure vessels. The suffix A indicates maximum temperature of 650°. B indicates 750°, using alloy spring; C indicates 900°, using alloy spring and carbon-moly. body. Pressure limits:

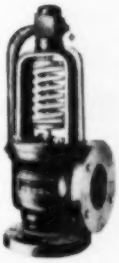
2575—300# 2576—450#
2577—600# 2578—900#

These valves are famous for their non-sticking qualities. Available in oversize orifices for greater capacity at slight additional charge.



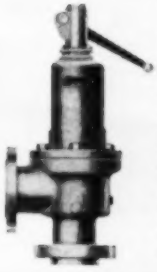
TYPE 2550

Made in Series 250 inlet, 125 outlet. Female outlet size available up to 4". Iron body, bronze or stainless steel trim. (Bronze trim has stainless steel disc as standard.) Stainless steel trimmed valves available with "FarriSeal" or "BalanSeal" bellows, with or without internal heat exchanger coil. Capacity advantages of full nozzle design



TYPE 2250

A.S.M.E.—N.B. Exposed Spring Boiler Safety Valve. 250# inlet, 125# female outlet to 4". Pressure and temperature limits 250# at 450°F. Available in stainless steel or bronze trim. Stainless disc on bronze trim, standard.



TYPES 2570 & 2550-OL

Made in Series 250 inlet, 125 outlet. Female outlet size available up to 4". Iron body, bronze or stainless steel trim. (Bronze trim has stainless steel disc as standard.) Stainless steel trimmed valves available with "FarriSeal" or "BalanSeal" bellows, with or without internal heat exchanger coil. Capacity advantages of full nozzle design. Type 2550-OL—Open Lever Construction; Type 2570—Packed Cap and Lever Construction.

TYPE 2745

Sizes ½", ¾" orifice No. 8 (area .019), No. 13 (area .077). 1" orifice No. 12 (area .045), No. 20 (area .250). By far the most outstanding advance in Safety Valve achievement. Nozzle capacity, blow down ring control, self aligning loose disc construction. Made from forged bar stock in four materials: brass, 304 and 316 stainless steel and cold rolled steel. Internal trim, 316 stainless steel. Both pipe connections in body for economical maintenance suitable for pressures to 10,000# on air, gas, oil and water. Type 2747—Packed Cap and Lever Construction.

TYPE 2740

½" x 1", ¾" x 1" with .049 area, 1" x 1" and 1" x 1½" with .18 area. A rugged, simplified design, limited capacity Safety-Relief Valve. Used by refineries particularly where extreme accuracy of blow-down is not essential. Uses: thermal reliefs, pump by-passes, etc.

TYPE 1430

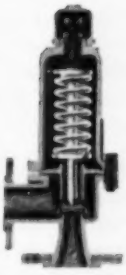
Sizes 1¼", 1½", 2" female inlet and outlet. Heavy duty Safety-Relief Valve, cast steel body, stainless steel trim, with flat seat and disc and blow-down ring for pressures up to 600#. Both pipe connections in body for economical maintenance. For gas or liquid service.

TYPE 1000

Diaphragm Control Relief Valve, sizes ½" to 2" male inlet, female outlet on bronze, 15 series inlet, 15 series outlet on Hastelloy "C" and type 316 stainless steel. Sensitive control with minimum bleed down. For chemical vapor-tight service—liquid or gas. Available with rubber, Neoprene, or molded Kel-F diaphragm and disc.

TYPE 3725

½" and ¾" orifice No. 13 (area .077). 1" orifice No. 20 (area .25). Made in female connections or Series 15, 30 or 60 flanges inlet. With rubber, Neoprene, or stainless steel "FarriSeal" bellows, Hastelloy "C" or 316 stainless steel body and disc. For highly corrosive acid services within the scope of 316 stainless steel and Hastelloy "C".



TYPE 3775

Sizes 1½" to 2", H orifice (area .785). Series 15, 30 or 60 inlet. Series 15 outlet. Rubber, Neoprene or 316 stainless steel "FarriSeal" bellows. Hastelloy "C" or 316 stainless steel body and disc. For highly corrosive acid services within the scope of 316 stainless steel and Hastelloy "C".

TYPE 1808

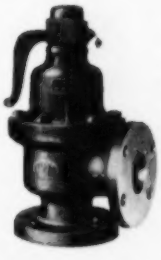
Sizes ½" to 2½". All Bronze Portable Pop Safety Valve. Male inlet, female outlet. A.S.M.E.—N.B. for steam or air services. Precise operation, economical first cost. Pressure to 250# steam.

TYPE 1400

Sizes ½" to 2½". Low Pressure Liquid Relief Valve, all bronze. Compact, adjustable range. Can be inspected and serviced without breaking pipe connection. Pressures to 250#.

TYPE 2350

Sizes 1½" x 2" to 6" x 8". Wing guided construction cast iron body, bronze trim. A.S.M.E. — N.B. Boiler Safety Valve, exposed spring, test lever. 250# inlet, 125# or female outlet to 4"



TYPE 2469

Sizes 1½" x 2" to 6" x 8". Wing guided construction, enclosed spring, test lever. A.S.M.E. — N.B. Cast iron body, bronze trim, 250# inlet, 125# or female outlet to 4".

ATPET 100

STATIC WATER DROP TEST (Interim MIL-P-17272 Ships)
Diesel fuel oil containing ATPET 100

Additive ATPET 100 Batch	NO. HOURS TO FAILURE	
	0.05% by Weight	0.1% by Weight
1	336*	312
	336*	312
2	336*	336*
	336*	336*
3	264	336*
	336*	336*
4	336*	336*
	336*	336*
5	240	336*
	240	336*
6	336*	336*
	336*	336*
7	336*	336*
	336*	336*

*Tests discontinued at this point—normally run only 48 hours.

ATPET 100

HYDROBROMIC ACID NEUTRALIZATION TEST (MIL-C-6529A)
Readings indicate samples passed (P) or failed (F)

Additive	% By Wt.	Approved 1100 Aviation Engine Oils						Approved 1010 Jet Engine Oils			
		Source #1		Source #2		Source #3		Source #4		Source #5	
		P	F	P	F	P	F	P	F	P	F
ATPET 100	4	6	0	4	0	22	2	4	0	4	0
ATPET 100	3	8	0	4	0	25	1	4	0	4	0
ATPET 100	2	3	2	6	0	24	0	4	0	4	0
ATPET 100	1	1	3	—	—	4	0	—	—	—	—
ATPET 100	0.5	—	—	—	—	2	0	—	—	—	—

ATPET 100

336-HOUR HUMIDITY TEST (MIL-C-6529A)

Additive ATPET 100	% By Wt.	Average hours to failure		
		Approved 1100* Aviation Engine Oils		Approved 1010* Jet Engine Oil
		Source #1	Source #3	Source #4
Batch 1	1	346	614	Less than 24
Batch 1	2	—	—	557
Batch 2	1	590	523	Less than 24
Batch 2	2	—	—	648
Batch 3	1	624	634	Less than 24
Batch 3	2	—	—	609
Batch 4	1	542	—	Less than 24

*Data has not yet been run on Source #2 and #5 oils.

ATPET 100

TURBINE OIL RUST-PREVENTION TEST (ASTM D 665-52T Modified)
Diesel Fuel Oil—3-Hour Duration

P—passed F—failed

Additive ATPET 100	Distilled Water 140°F. minimum concentration tested .001% by Wt.		Sea Water			
			.02% by Wt.		.04% by Wt.	
	No. tests	Results	No. tests	Results	No. tests	Results
Batch 1	2	2P	2	2F	—	—
Batch 2	3	3P	—	—	—	—
Batch 3	2	2P	—	—	—	—
Batch 4	2	2P	—	—	—	—
Batch 5	2	2P	—	—	2	2P
Batch 6	2	2P	2	2F	—	—
Batch 7	2	2P	2	2F	2	2P
Batch 8	2	2P	2	2F	2	2P

By every test...

ATPET 100

Corrosion Inhibitor rates high

ATPET 100, the new 100% active, non-metallic corrosion inhibitor made by Atlas, proves superior under all standard tests. The data tabulated here show its excellent performance and uniformity from batch to batch, even when used in small concentrations.

ATPET 100 adds anti-rust protection to engine preservative oils, slushing oils, turbine oils, film type inhibitors and #2 fuel oils. It's priced in the range of metallic inhibitors. Write to Atlas today for Atpet Test Report No. 3, and for samples for evaluation in your own product.

INDUSTRIAL CHEMICALS DEPARTMENT
ATLAS POWDER COMPANY
WILMINGTON 99, DELAWARE
offices in principal cities
ATLAS POWDER COMPANY, CANADA, LTD.
BRANTFORD, CANADA

When something's got to give
to compensate for expansion,
contraction, vibration, rotation or strain,
in your piping system or equipment,
it will be far, far better for you
if the "something" that gives
is a Zallea Expansion Joint
and not your expensive piping.
Since piping damage usually
means down-time, it pays
to provide positive, over-all protection.

The expansion joints illustrated,
duo-equalizing, hinged, and universal,
are just a few of the Zallea family
of expansion joints available
to help solve your piping problems.

Regardless of piping movement,
whether axial, lateral, rotational,
etc., Zallea already has, or will
design, an expansion joint to absorb it.
For information on standard types,
request Bulletin 351. For consultation
on special problems, ask us to
have our representative call.

Zallea
expansion joints

ZALLEA BROTHERS, 890 LOCUST STREET, WILMINGTON 99, DELAWARE
World's Largest Manufacturers of Expansion Joints

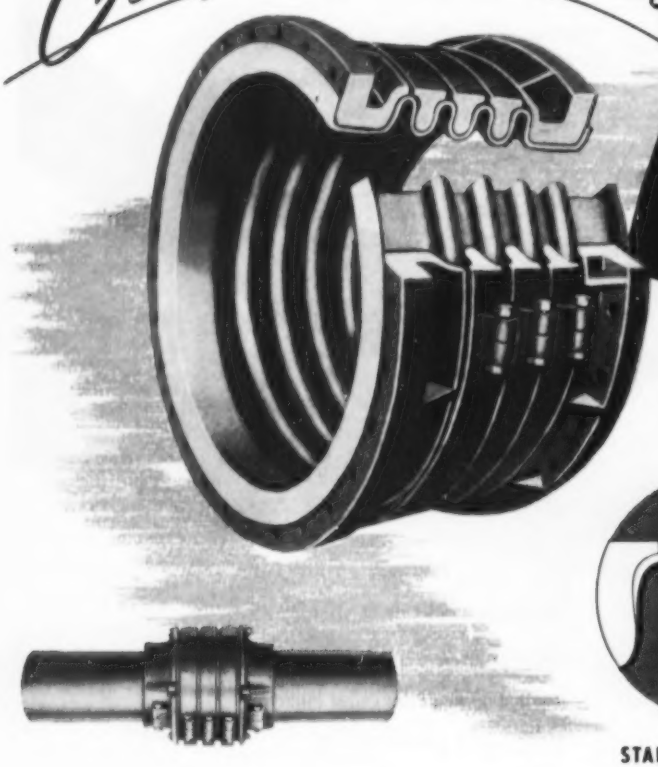
For more data on advertised products, use Readers' Service Cards, last page.

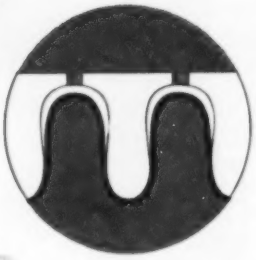
BADGER *Expansion Joints*

Typifying Joint Engineering at its Best

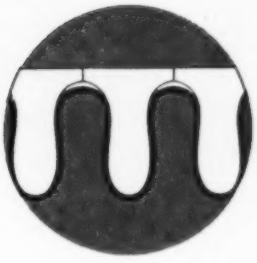
Controlled Movements

through DIRECTED FLEXING





STARTING POSITION
(LINE COLD)



FINAL POSITION
(FULL TEMPERATURE)

WITH THE OLD STYLE corrugations, there was little control over the flexing movement. Our engineers long ago found this to be a major cause of uncertain joint life and set about to solve the problem.

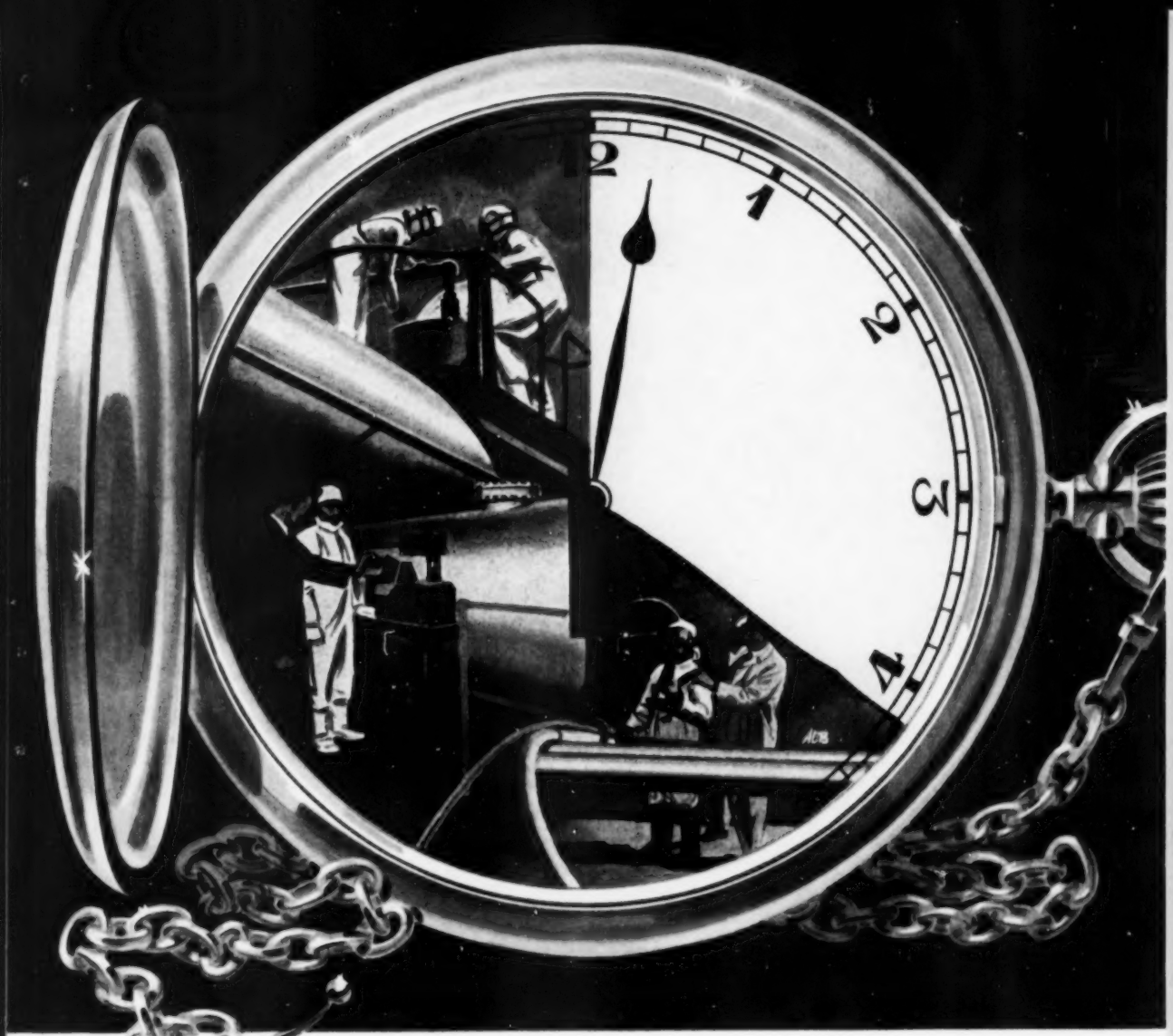
Directed Flexing, based on a scientifically engineered design of all-curve corrugation, solved the problem. That was some years ago. Notwithstanding continual further studies, nothing anywhere has supplanted Directed Flexing as a major design factor in long joint life. It's another example of what engineering has done to make the Badger Expansion Joint 'tops' in its field.

Badger Expansion Joints come in a variety of types and a wide range of sizes: Directed Flexing, Self-Equalizing for normal and long traverses and higher pressures; Non-Equalizing, for short traverse or when pressures are low; Tandem Joints for combination axial and lateral movements; Clevis-Hinged Joints for angular movements; Special Vibration Control Joints; Flexible Pipe Line Seals for watertight connection between pipes and flood walls.

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE • MASS.



How to squeeze 31 years' experience into 21 minutes

We have yet to find an oil-company executive who doesn't put the safety of the people in his plant above every other consideration. And this, in large part, explains the remarkable safety record of the industry.

As part of the petroleum industry, we've shared this concern for employee safety for more than 31 years. To help you teach your employees how to handle "Ethyl" antiknock compound, we've developed demonstrations, live shows, charts, booklets, and other educational aids.

Now, with the expansion of the petroleum industry, the need for training new employees has so increased that we have streamlined and expanded our safety program. The core of our new program is a series of five unforgettable "how-to" movies. Each film will squeeze into approximately twenty-one minutes all the things we have learned about the various phases of safety.

The first film of the program—a color animation—covers the operation of a mixing plant. Since its release some months ago, it has become an important

(Continued on next page)

Printed in U. S. A.

(*Continued from preceding page*)

part in the personnel training of many companies. Our second film, entitled "Safety Precautions and Medical Regulations," is also in color and will be ready for release shortly.

Any of our safety engineers will welcome the opportunity of discussing with you how these films may be fitted into your own safety program. More films are planned for the future—each to run about the same length of time and each to cover a different phase of working with "Ethyl" antiknock compound.

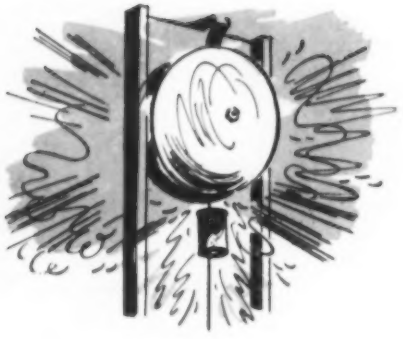
To our way of thinking, safety service is one of the most important services we render our customers. Every year brings a fresh crop of young, inexperienced workers who must be taught to believe in accident-proof methods. And, of course, the interest of the experienced workers in playing it safe must be maintained at all costs.

We share with the petroleum industry the firm conviction that people are its greatest investment. We are confident that our new training tools will enable our safety engineers to assist you in doing an even better job of protecting that investment in the future.

ETHYL CORPORATION

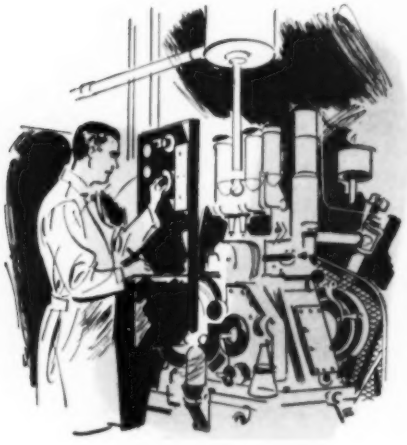
NEW YORK 17, NEW YORK

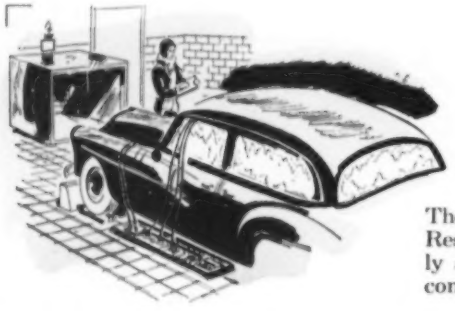
WORTH NOTING



Ethyl's national advertisements promoting your best gasoline are consistently among the best-read advertisements in the magazines in which they appear!

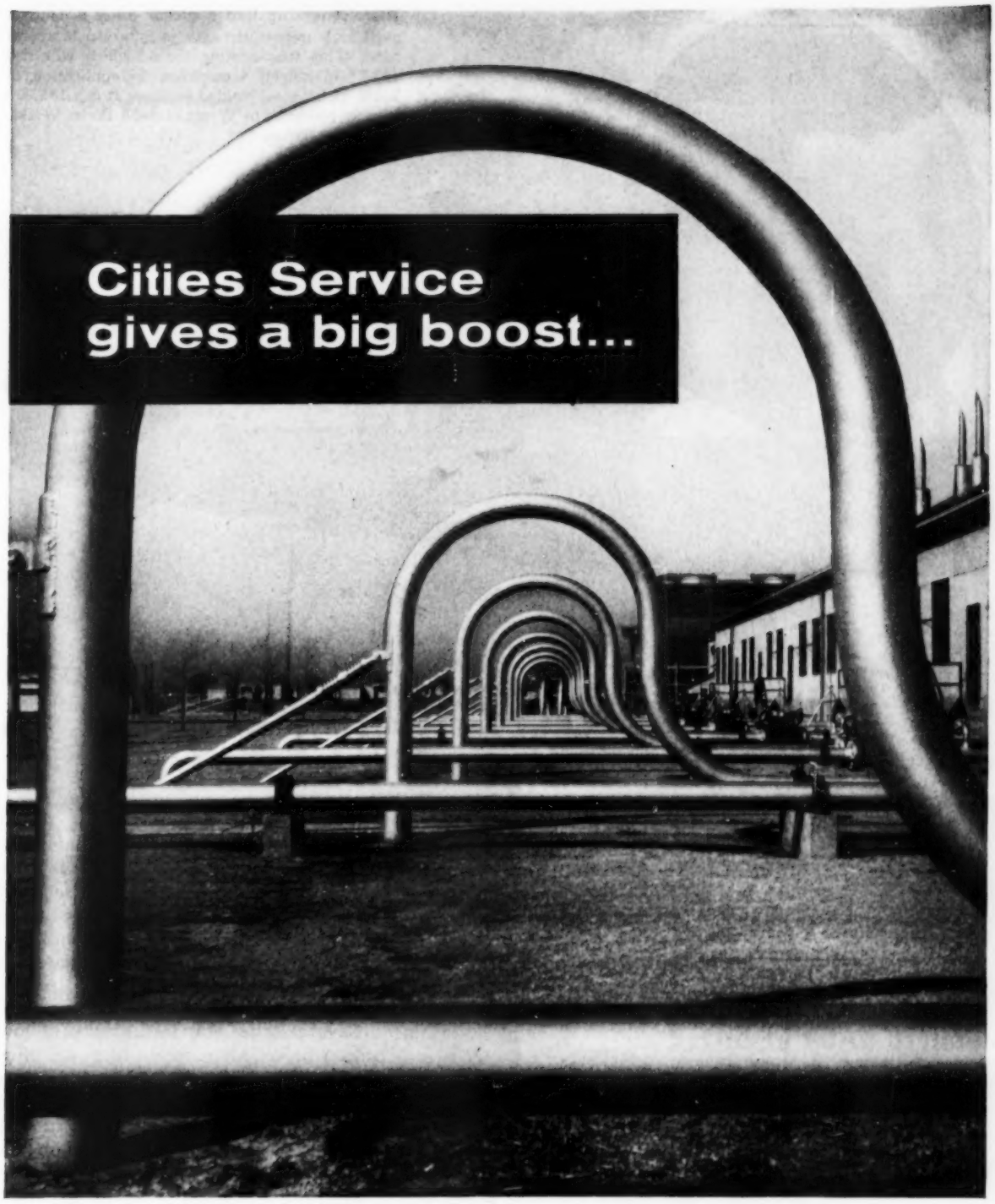
More than 15,000 gasoline samples are tested at Ethyl's five gasoline testing laboratories each year to furnish refiners with accurate gasoline quality reports.





The "all weather" room at Ethyl's Detroit Research Laboratories can duplicate nearly any temperature, humidity and wind condition encountered in car operation.

Ethyl service is backed by 31 years of antiknock experience

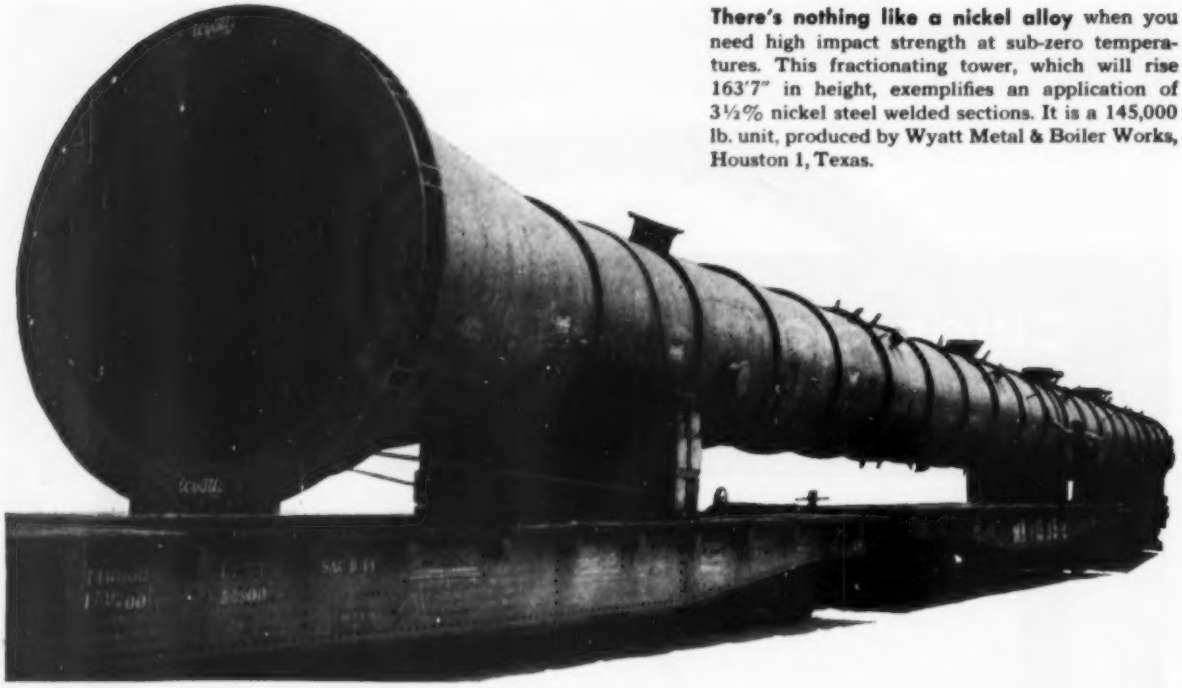


Every minute, day in day out, 1,200,000 cubic feet of natural gas are pushed through pipe lines by the 220,000 horsepower in our booster stations.

CITIES SERVICE

A Growth Company

For more data on advertised products, use Readers' Service Cards, last page.



There's nothing like a nickel alloy when you need high impact strength at sub-zero temperatures. This fractionating tower, which will rise 163'7" in height, exemplifies an application of 3½% nickel steel welded sections. It is a 145,000 lb. unit, produced by Wyatt Metal & Boiler Works, Houston 1, Texas.

A Tower of Strength at -160° F.

YOU KNOW how low-temperature embrittlement affects equipment, particularly that built for controlling reactions, liquefaction and fractionation of gases . . .

And you know how carbon steels and many alloy steels quickly lose impact strength when temperatures fall below −50° F.

A solution to the problem, however, requires no hand-tailored steel. In fact, when your equipment needs toughness in addition to good strength properties at sub-zero temperatures, you can safely give the job to an appropriate *standard grade of nickel alloy steel.*

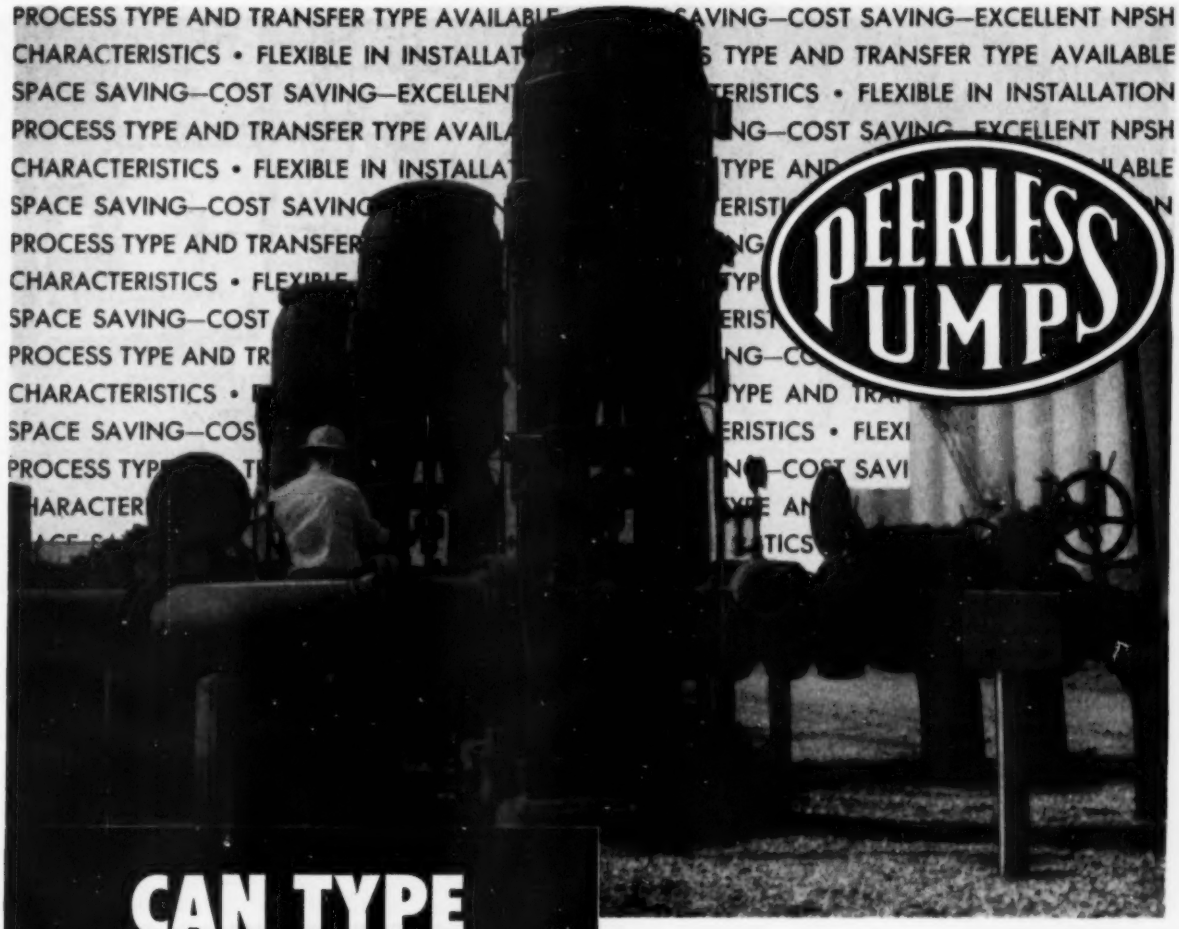
For an example, look at the fractionating tower, above. The builder, Wyatt Metal & Boiler Works of Houston, Texas, produced it from a standard grade of low carbon nickel alloy steel. This grade, containing 3½ percent nickel, was selected for ready response to fabricating operations and welding, as well as for ability to resist shock at temperatures down to −160° F.

Several other standard grades of low carbon nickel alloy steels, likewise, offer impact strength at levels that qualify them for low-temperature use. In addition, all these grades provide properties to meet a variety of fabricating and service demands.

No matter what your metal problem, you can usually solve it by using the correct nickel alloy. Send details of *your* difficulty, for our suggestions. As the first step toward getting rid of such trouble . . . write us now.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

For more data on advertised products, use Readers' Service Cards, last page.



CAN TYPE VERTICAL PUMP

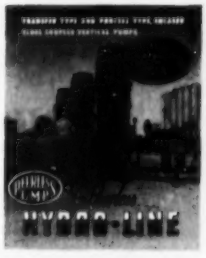
Now Available in Two Types—FOR APPLICATION to CHEMICAL PROCESSING, REFINING TECHNIQUES, CONDENSATE SERVICE, AND LINE BOOSTER SERVICE

NEW DESIGNS PROVIDE BOTH A PROCESS TYPE AND A TRANSFER TYPE

The process type vertical Hydro-Line pump, especially suited to refining and process pumping offers the following features—1) API-ASME code welding; 2) especially designed containers for either mechanical shaft seals or packing; 3) availability of head and barrel flanges up to 300 lbs. or more; 4) extra heavy wall thicknesses for maximum stability and high safety factor; 5) elliptical barrel bottom design for optimum fluid entrance conditions. The transfer type Hydro-Line pump is of a similar design to the process type differing in materials of construction required for less rigorous service. Both types are extremely flexible in installation, are easy to inspect, service and maintain—can be designed for operation on any available system NPSH. Write for new Bulletin No B-1700.

THE PEERLESS
HYDRO-LINE
ENCASED CLOSE-COUPLED PUMP

CAPACITIES TO	3000 gpm
HEADS TO	1000 feet
DRIVES	As required, vertical solid shaft, or explosion-proof motors; steam turbine.
TEMPERATURES	Up to 400° F.



PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories at: Los Angeles, Calif., and Indianapolis, Ind.
Offices: New York; Atlanta; Chicago; St. Louis; Indianapolis; Phoenix; Fresno; Los Angeles; Dallas, Plainview and Lubbock, Texas; Albuquerque, New Mexico.
Distributors in Principal Cities; Consult your Telephone Directory.

PEERLESS PUMPS

fmc

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, California

Please send me a copy of Peerless Hydro-Line Pump Bulletin No. B-1700.

NAME _____

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TOWN _____ STATE _____

Pet. Refiner

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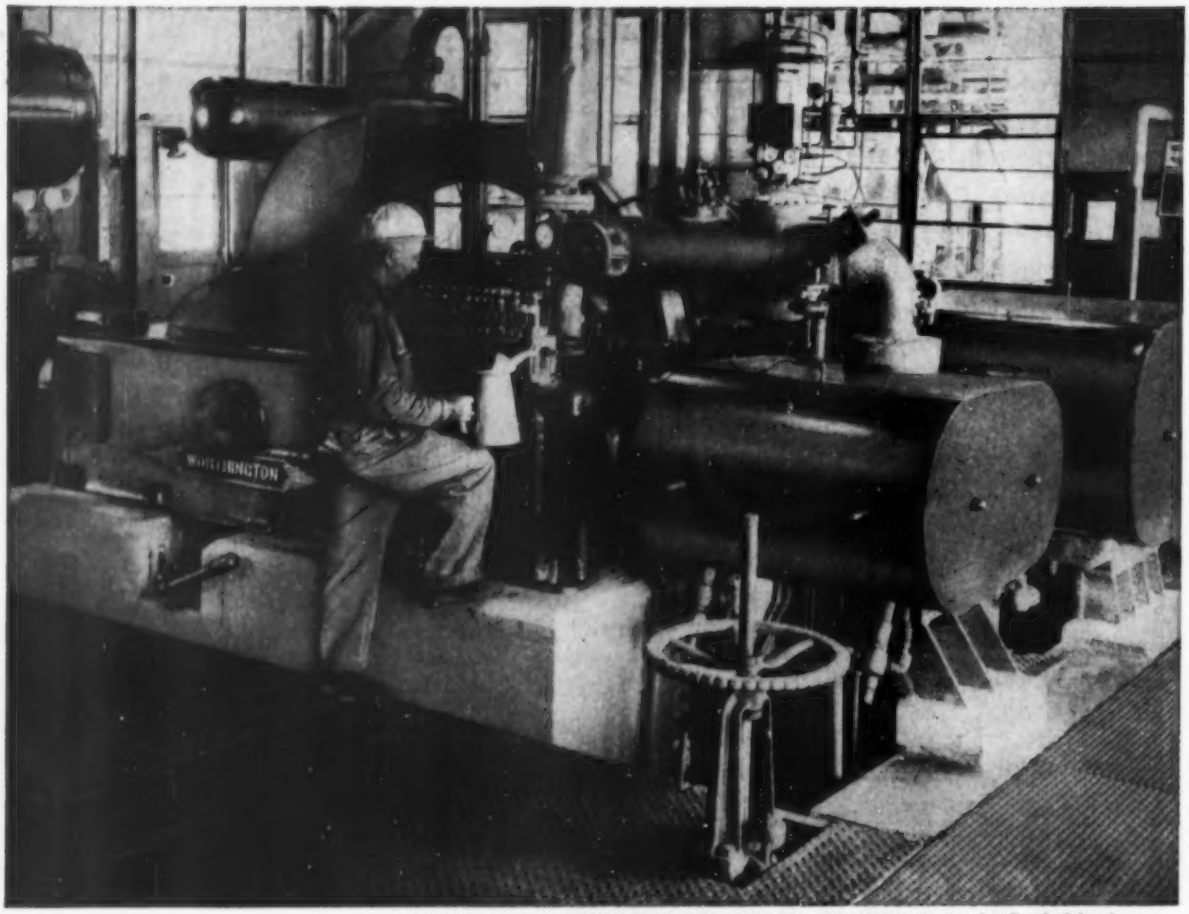


AVAILABLE STEAM DRIVES THIS WORTHINGTON COMPRESSOR at the Rock Island Refining Company in Indianapolis. Part of the hydrocarbon gas being compressed is taken off between compression stages and used to move a catalyst from storage.

Power failure won't stop this compressor

It's a Worthington *steam-driven* compressor which supplements a motor-driven compressor at the Rock Island Refining Company's plant in Indianapolis.

Here's the way Rock Island works it: the motor-driven machine (also a Worthington) is operated as a base load unit. The steam-driven compressor floats on the line, handling any swings in capacity by an increase or decrease in speed. And it's easy to vary the speed — and hence the capacity — by simply turning hand-wheels which control the amount of steam admitted to the compressor. If electrical power fails, the steam-driven unit can take over the entire compression job almost immediately. Result — process keeps going.

Five years of almost continuous operation have shown that the addition of the steam-driven Worthington was a wise move. One of the many features responsible for the fine performance record of this sturdy compressor is the exclusive Worthington Feather* Valve — the lightest, tightest, most efficient valve made. It's standard equipment on every Worthington compressor.

We'd like to help with your compressor problem, too. Write us. Worthington Corporation, Water Cooled Compressor Division, Section K.3.6, Buffalo, N.Y.

WORTHINGTON* *Reg. U.S. Pat. Off.* K.3.6

Only Worthington Compressors Give You Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors

In its first year TCP...

the Greatest Gasoline Development in 31 Years... has re-powered 8 million engines

TCP*, the shell discovered additive, blended into Shell Premium Gasoline, controls pre-ignition and spark plug fouling caused by lead and carbon deposits. Increases power up to 15% ... spark plug life up to 150%

An entirely new gasoline, Shell Premium Gasoline with TCP, was first introduced to American motorists 12 months ago.

Because it overcomes the greatest cause of power and fuel loss affecting today's engines, it was hailed as the greatest fuel development since the introduction of tetraethyl lead in gasoline back in 1922.

In the first year following its announcement, Shell Premium with TCP has met with outstanding success. It has re-powered more than 8 million engines.

If you are not among the millions of motorists who are enjoying its benefits today, it will pay you to do so.

Shell Premium with TCP will increase the power of your engine up to 15%. It also prolongs the life of your spark plugs up to 150%.

Shell Premium with TCP is an exclusive development of Shell Research and is available at all Shell Dealer Stations.

*TCP: the unique gasoline additive discovered by Shell Research. Only Shell and its authorized licensee, Continental Oil Company, have the full knowledge of the proper use of TCP additive. Trademark owned and patent applied for by Shell Oil Company.

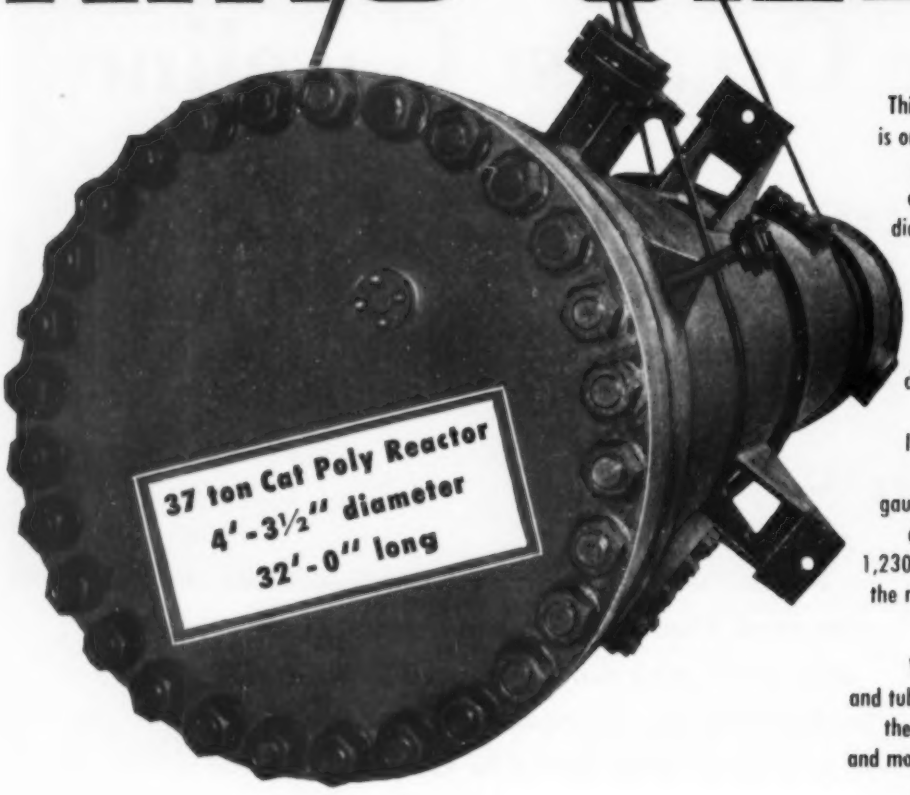
SHELL

SHELL PREMIUM GASOLINE *with TCP*

The most powerful gasoline your car can use

For more data on advertised products, use Readers' Service Cards, last page.

KING SIZE



This giant 37 ton Cat Poly Reactor is one of 4 units shipped to a large petroleum refinery in the State of Washington. It is 4'-3½" in diameter by 32'-0" long and has a 1 3/16" thick shell. Each of its 8" thick heads is attached to the shell channel with 28 special alloy stud bolts 2¾" diameter by 15¼" long having nuts 4¼" across the flats. Into the 5¾" thick tube sheets 190 tubes, 2½" O. D., No. 5 gauge and 30'-0" long, are rolled and seal welded. Designed for 1,230 lbs. pressure on the tube side, the reactor was completely X-rayed and stress relieved.

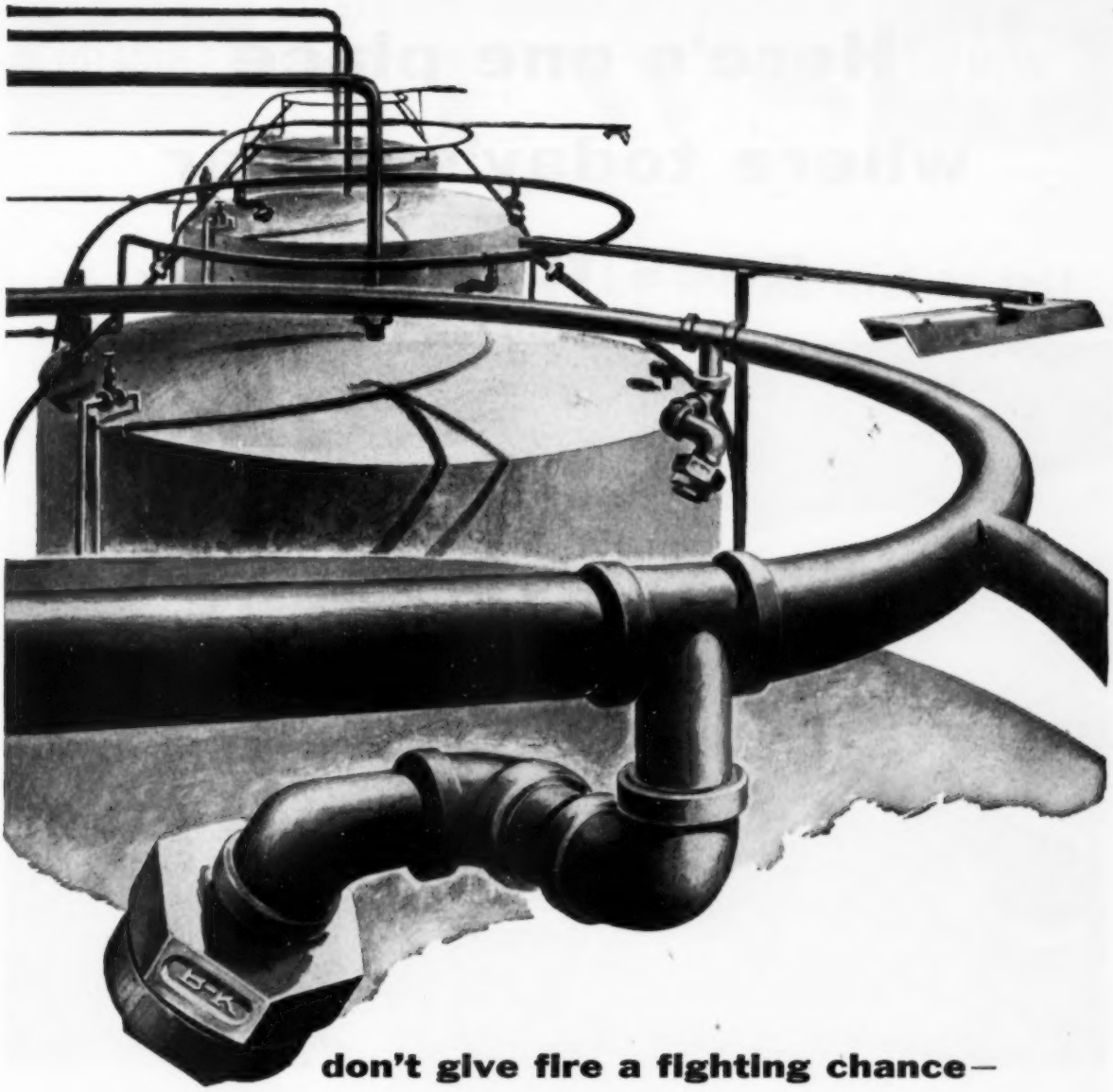
Vogt, a leading builder of shell and tube reactors for poly plants, has the competently skilled personnel and modern mechanical facilities with which to provide heat transfer equipment for the most exacting services in petroleum refineries, chemical plants, and related industries.

Reactors ...by Vogt

A bulletin describing the wide range of heat transfer equipment built by Vogt is available upon request.

HENRY VOGT MACHINE CO., LOUISVILLE, KENTUCKY

BRANCH OFFICES: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.



don't give fire a fighting chance—
Install a Blaw-Knox Automatic Fog System

A single Blaw-Knox Fog Nozzle, shooting its dense, quenching fog into the very heart of a starting fire, can accomplish more than several hose streams each having ten times its capacity.

Controlled by rate-of-rise thermostats, Blaw-Knox Fog Nozzles protect you around the clock, sounding alarms and putting water to work instantly wherever and whenever needed. Their finely divided fog rapidly extinguishes the fire, dissipates heat, prevents development of high temperatures and bursting pressures, confines damage to a small area.

Multiply this kind of fire fighting efficiency in a system engineered to guard against your specific hazard and you are assured of a maximum of protection.

Why not let a Blaw-Knox Fire Protection Engineer study your needs and submit a cost estimate and preliminary layout?

You'll be interested in the new Blaw-Knox booklet, "*Fire Can Destroy Your Business.*" There's no charge. Write for it.

"Little Joey Sprinkler" always on the job

BLAW-KNOX FIRE PROTECTION SYSTEMS CARRY APPROVALS OF ALL INSURANCE UNDERWRITERS • *Deluge Systems* • *Wet Pipe Systems* • *Dry Pipe Systems* • *Water Spray and Fog Systems* • *Rate-of-Rise Sprinkler Systems* • *Foam and Carbon Dioxide Extinguisher Systems*

BLAW-KNOX COMPANY

Automatic Sprinkler Department / Pittsburgh 33, Pennsylvania

BLAW-KNOX

For more data on advertised products, use Readers' Service Cards, last page.

Here's one place where today's dollar goes further

In the fondly-remembered time of the nickel trolley and the 25¢ T-bone, gasoline for dad's 1925 model cost about 18¢ a gallon (excluding taxes). Sounds like a bargain—yet it really cost *more* than today's gasoline. The reason is clear when you keep this fact in mind: You fill your car's tank with gasoline, but what you're actually buying is *mileage*. Naturally, you'd rather pay $1 a gallon for gas that gave you 100 miles a gallon than buy 10¢ gas that delivered only 5 miles to the gallon. And that's why today's gasoline costs less than motor fuel of 1925 . . . it gives you *more miles to the dollar*. Research by companies such as Standard Oil Company of California has improved gasoline spectacularly over the years. This better motor fuel made more efficient auto engines possible, and together they give you up to 50% better mileage than motorists got in the '20's. On top of that, competition between oil companies has helped to hold down gasoline prices. Since 1925, they've risen only 20% (excluding taxes) while food has gone up 70%, clothing 63%, and the cost of living 53%. Compared to practically anything else you buy, gasoline is still a bargain. Any way you look at it, your money goes further when it goes for today's finer gasoline that gives you more miles to the dollar.

STANDARD OIL COMPANY OF CALIFORNIA

75 years of planning ahead to serve you better

For more data on advertised products, use Readers' Service Cards, last page.

DU PONT REG. U.S. PAT. OFF.

PETROLEUM CHEMICALS DIVISION

NEWS

DU PONT REG. U.S. PAT. OFF.

August ★ One of a Series of Interest to the Petroleum Industry ★ 1954

Research Paves Way for Production and Employment

Over the past quarter century, for every dollar Du Pont has spent for laboratory research, it has spent three dollars in productive facilities.

Research in the same period cost $475 million, exclusive of buildings and equipment. And employment soared from 38,000 to more than 90,000.

During the same span, expenditures for new plants and facilities amounted to $1,400 million. This is a ratio of three production dollars for one research dollar.

New Booklet on Du Pont Metal Deactivator

Many refiners are giving increased attention to the problem of the effect of metals on gum formation. To aid them in solving this problem, the Du Pont

Petroleum Chemicals Division offers a comprehensive new booklet which discusses the aspects of gum prevention.

The booklet traces the sources of metallic contamination. And findings of a recent service station survey on the prevalence of copper and gum in gasolines are included. There are also many helpful hints and detailed instructions on combatting gum formation with Du Pont Metal Deactivator.

Application and Costs

The booklet discusses methods of adding Du Pont Metal Deactivator and quantities needed to prevent metallic reaction. And it presents a cost study on the use of DMD. Other valuable information includes chemical reactions, handling and shipping. In all, there are 20 pages of facts with answers to practically any question you may have regarding the use of DMD.

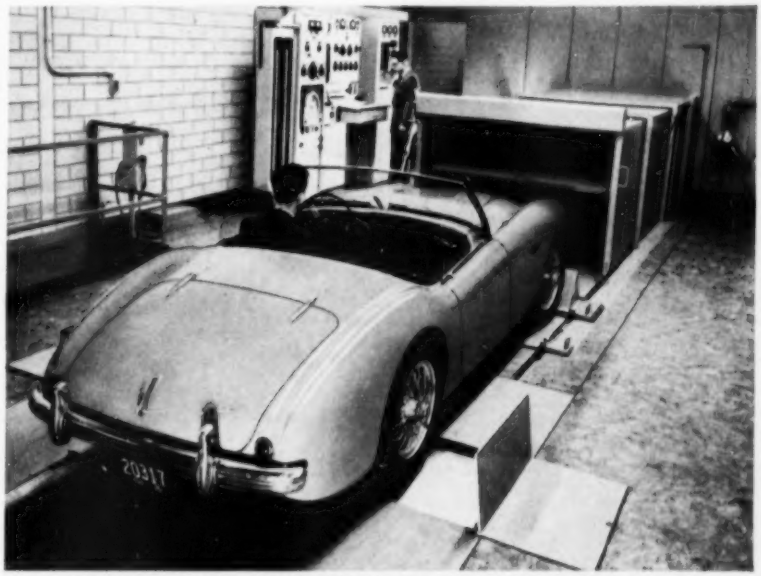
The new booklet is yours on request from any Du Pont representative or regional office.

Mileage by the roomful to test automotive fuels and lubricants

How is gasoline efficiency affected by high-speed, high-temperature operation?

What happens to a lubricant in the hectic start-and-stop maneuvering through city traffic?

Questions like these become more important today as high-speed superhighways weave a network across the country, and the tangle of city traffic grows more knotty.



DEVELOPING FUELS AND LUBRICANTS FOR TOMORROW'S CARS calls for extensive road testing. To accelerate this work, the Du Pont Petroleum Laboratory has brought the highway indoors with this ingenious chassis dynamometer.

The new chassis dynamometer at Du Pont's Petroleum Laboratory gives interesting answers. It is an important source of information for the automotive engineers taking part in Du Pont's research concerned with additives designed to improve fuel and lubricant performance.

How It's Done

Speeds up to 90 mph can be simulated on the dynamometer. Radiator windage can be synchronized to the simulated speed of the car. Inertia flywheels create road conditions by varying "load."

Five flywheels can exert a load in multiples of 500 pounds up to two and

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

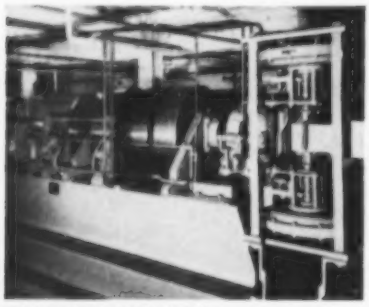
DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *Dynamometer*

three quarters tons. Engineers operate this versatile setup from a central control panel where detailed data on test factors are also recorded.



THE INERTIA FLYWHEELS, a useful feature of the Petroleum Laboratory's chassis dynamometer, simulate "load" on the car or truck being tested. The two large wheels on the right represent 2,000 pounds each, the next one is 1,000 pounds, and a 500-pound wheel is shown at the left.

THIS FAN is used to generate windage through the car's radiator. It allows the dynamometer to simulate actual radiator operating conditions, at speeds up to 90 mph.

Results

Information learned from tests in Du Pont's new chassis dynamometer will aid in matching vehicles, fuels and lubricants to the changing patterns of modern driving conditions.

As data from these tests are collected and evaluated, they will be made available to the petroleum and automotive industries.

Manager of New San Francisco District

JOSEPH G. EVANS

Because of increasing activity on the Pacific Coast, and as an added service to refiners, a new district has been created by the Du Pont Petroleum Chemicals Division's West Coast Region.

Assigned to the post as manager of the San Francisco District is Joseph G. Evans who joined Du Pont in December 1951.

Mr. Evans is a graduate of Texas A & M and started with Du Pont as a sales-service representative of the Petroleum Chemicals Division in Tulsa, Oklahoma.

Previous to this he was Development Engineer for the Standard Stoker Company of Erie, Pennsylvania, and later formed his own company handling specialized industrial chemicals and automotive lubricants.

Mr. Evans spent three years in the Pacific as an officer in the Naval Submarine Service during World War II. He was later recalled to active duty during 1950-1951 to serve on the destroyer U.S.S. McCaffery off Korea.

Du Pont additive improves diesel fuel production 4 ways

You may know Du Pont Fuel Oil Additive No. 2 as an effective stabilizer and dispersant for distillate heating oils. But do you also know that F.O.A. No. 2 does some remarkable things when added to diesel fuel?

It permits blending of cat-cracked and straight-run stocks. Refiners get more flexibility and greater capacity in diesel fuel production.

Certain amounts of heavy distillate fuel oils treated with Fuel Oil Additive No. 2 can be added to diesel fuel without affecting filterability. In this way the additive permits upgrading of heavy oils.

It reduces particle size of insoluble residues, and retards their formation as well. Result—F.O.A. No. 2 helps to end clogging of diesel filter screens.

The fourth advantage of F.O.A. No. 2 in diesel fuels is that, being ashless, it simplifies the problem of meeting ash specifications. Since it leaves no combustion chamber deposits, it does not contribute to exhaust sparks.

Storage tests indicate that this highly concentrated chemical additive gives most satisfactory results when added to freshly prepared stocks at the refinery.

LITERATURE AVAILABLE

Here is a partial listing of the bulletins, reports, booklets, technical papers and aids available to you through any of the Du Pont Petroleum Chemicals Division regional offices listed below:

Du Pont Fuel Oil Additive No. 2—A 12-page bulletin describing this ashless stabilizer and dispersant which prevents clogging of fuel oil screens . . . A-6522

Du Pont Metal Deactivator—A new, comprehensive, 20-page booklet which discusses every aspect of copper contamination and methods of metallic gum prevention using Du Pont Metal Deactivator, A-7300

Film Library—A new catalog, listing films which are available for oil company use. This listing includes the Du Pont "Cavalcade of America" TV library A-7549

DU PONT

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • *Wilmington 98, Delaware*

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NEW YORK, N. Y.—1270 Ave. of the Americas — Phone COlumbus 5-3620
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TULSA, OKLA.—1811 So. Baltimore Avenue — Phone Tulsa 5-5578
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A-7724

Printed in U. S. A.

Acid for Uranium

from Chemico-Built Plants

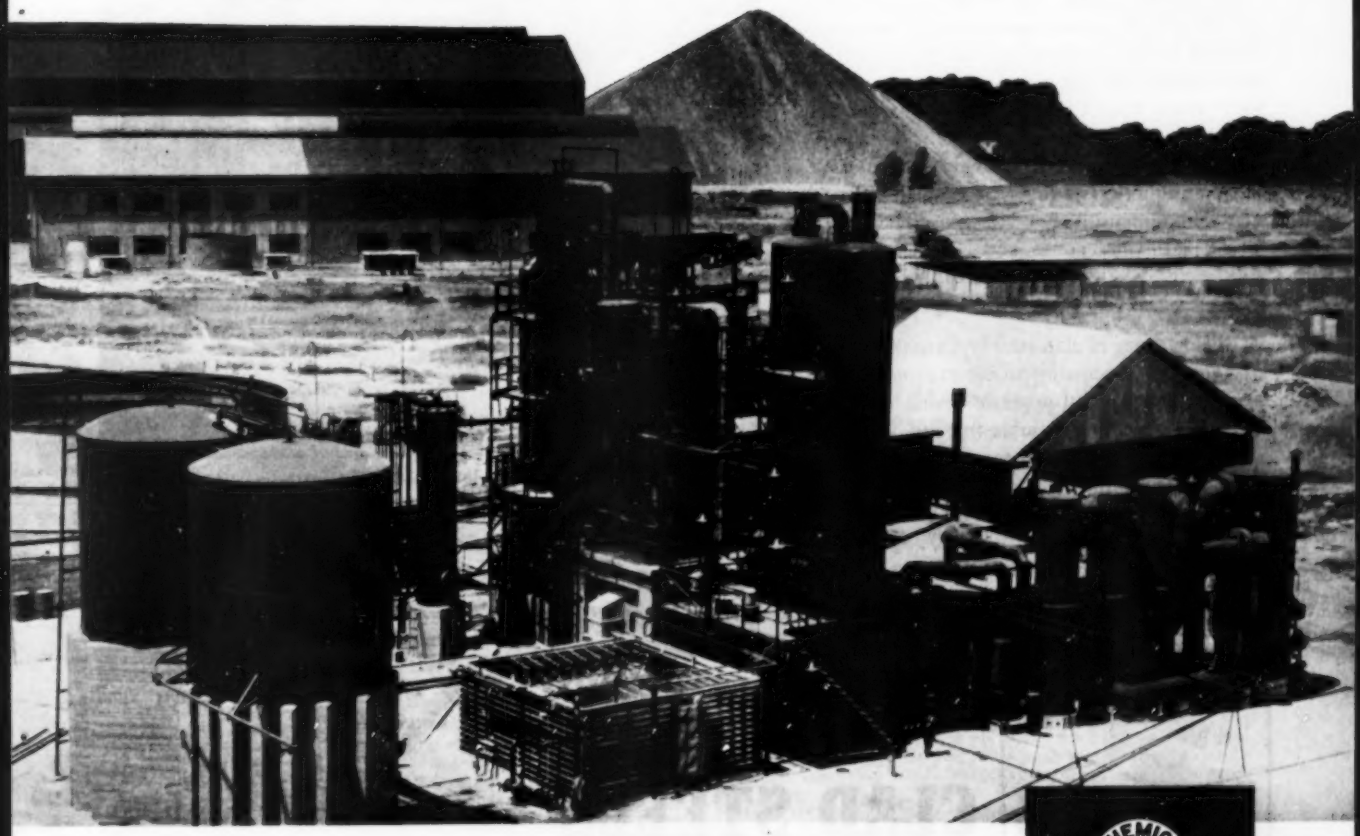
The leaching of uranium ores requires substantial quantities of sulfuric acid. To help meet this need, Chemico designed and supplied this plant in South Africa for an important producer of uranium. It is the first of five Chemico plants which are now operating or nearing completion in South Africa alone for this purpose.

Designed and delivered on a rush schedule, this plant went into smooth and full operation promptly on completion and is running consistently above rated capacity.

Chemico's service goes with its plants wherever they are installed. Even at this distant location, skilled Chemico engineers supervised the construction and initial operation of the plant and trained the operators until they were thoroughly familiar with its working.

Here is another example of Chemico's widespread activities, constantly enlarging the scope of its experience.

We welcome your inquiries on any heavy chemical production problem. No obligation, of course.



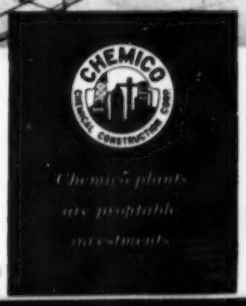
CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

CABLES: CHEMICONST, NEW YORK

TECHNICAL REPRESENTATIVES: CYANAMID PRODUCTS LTD., LONDON • CHEMICAL CONSTRUCTION (INTER-AMERICAN) LTD., TORONTO • SOUTH AFRICAN CYANAMID (PTY) LTD., JOHANNESBURG



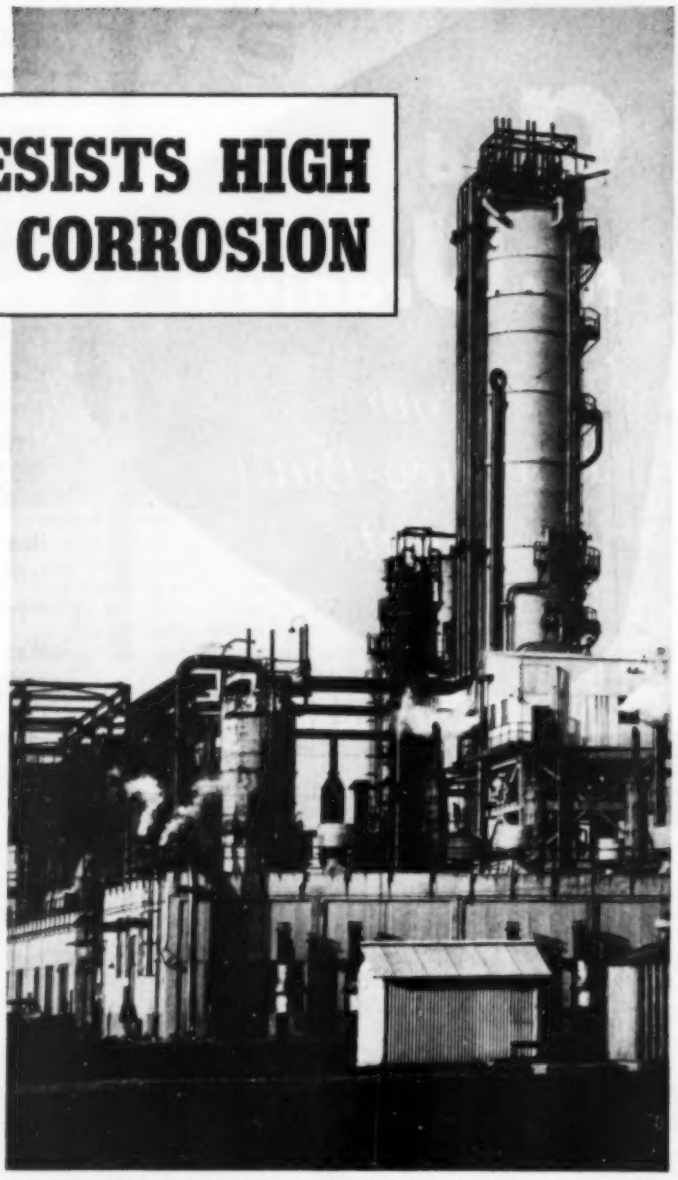
CE 350

CLAD STEEL RESISTS HIGH TEMPERATURE CORROSION

High sulphur content of varying feeds in this catalytic cracking unit made corrosion resistance vital if maintenance were to be kept down. To meet this threat effectively and *economically*, the equipment engineers recommended the use of clad steel in construction. Type 405 stainless-clad steel gives effective corrosion resistance in the reactor, where temperatures range from 925° to 950°F. In addition, in the lower portion of the fractionating tower, Type 405 stainless-clad stands up to sulphur corrosion at the 650°F. operating temperature.

Even though feeds vary from heavy vacuum gas oil to light gas oil, operation has been continuous except for scheduled yearly inspection shutdowns since the unit went on stream over four years ago. Chances of an unscheduled shutdown or equipment failure interrupting throughput are reduced, and maintenance is held to a minimum. The layer of stainless, permanently and integrally bonded to low-cost carbon steel backing plate, does the job of the expensive solid alloy. Clad steel eliminates the danger of seepage or crevice corrosion.

A wide range of clad steel types makes it easy to meet your processing problems *economically*. Clad steel tanks and pressure vessels minimize first cost, have long, trouble-free life, will withstand high pressures and temperatures, permit easy and economical field erection. A combination of versatile clad steels and modern fabricating techniques, teamed with sound engineering, will give you these benefits. Working in close coordination with your engineers and consultants *from the start*, a qualified fabricator can tailor equipment to your exact processing needs.



Type 405 stainless-clad steel in the lower 92 feet of this fractionating tower resists sulphur corrosion economically at 650°F. At even higher temperatures of 925°-950°F. in the reactor, the same clad steel is used to resist corrosion.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or, contact Manager, Marketing Service, Lukens Steel Company, 681 Lukens Building, Coatesville, Pa.

LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

For more data on advertised products, use Readers' Service Cards, last page.

How would YOU solve these two problems?

1. A PATCH AHEAD OF TIME, applied at the factory, reinforces the knees of dungarees and overalls. Patches are vulcanized under pressure with Radio Frequency Corp.'s high frequency, dielectric heater. If dielectric heat, generated in the material, is lost through conduction, vulcanization becomes inefficient. But Fenwal THERMOSWITCH® units in each platen minimize these losses by close temperature control. Vulcanizing 3000 patches per hour is now standard; 30 was.

2. DENTAL PLATE FIT STARTS WAY BACK. The tiny abrasive wheels for grinding and polishing dental plates must be very accurately molded of fine abrasive in a rubber base. The molds in which they're made must have delicate temperature control for consistent quality and uniformity. The manufacturer, The Wm. R. Hall & Son Co., uses THERMOSWITCH units in molds for accurate, reliable temperature control. Production figures can be kept high while rejects are low.

3. THIS IS IT — the Fenwal THERMOSWITCH control is simple — compact shell contracts or expands *instantly* with temperature changes, opening or closing electrical contacts. Adjustable and highly resistant to shock and vibration. Fenwal THERMOSWITCH units are solving temperature problems and helping to improve the final product throughout all industry.

4. SEND FOR THIS BROCHURE for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal Incorporated, 108 Pleasant St., Ashland, Massachusetts.

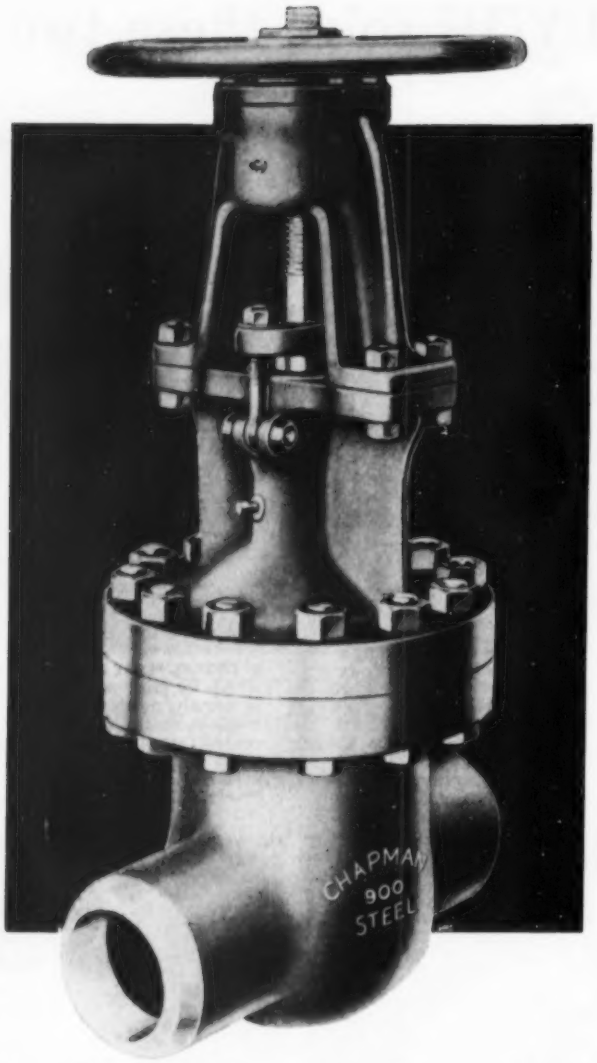
Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE... *but only to heat*

For more data on advertised products, use Readers' Service Cards, last page.



Special Qualities at Standard Prices
...in CHAPMAN Steel Valves

When you buy Chapman Steel Valves, you buy dependable operation and low maintenance cost — you can select steels to meet your specifications from over a dozen alloys made in Chapman's own steel foundry, under rigid scientific supervision.

When your valves are Chapman, you're sure they seat tightly and accurately, without jamming, chattering or wearing excessively. Close tolerances mean long service and little maintenance.

The Chapman Steel Valve line is complete — gates, globes, and checks for all pressure classes . . . 150, 300, 400, 600, 900 and 1500 pounds, and for a temperature range of -150°F to 1000°F. Valves are supplied with bolted or welded body and bonnet joints and flanged or welding ends to meet service requirements.

Chapman's long experience and mass production mean economies. Quality is unsurpassed. So it pays to see Chapman first for every steel valve requirement . . . standard or special, gate, globe, angle or check. Chapman Steel Valves equal or exceed A.P.I. standards in every range. Write for Catalog No. 20.

The CHAPMAN Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

NOW! FISCHER & PORTER'S COMPLETE CENTRALIZED CONTROL INSTRUMENTATION

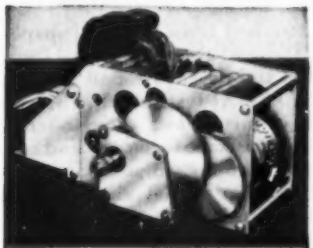
Includes Data Reduction Systems

Right from the day you recognize the need, Fischer & Porter Company will plan with you for complete process instrumentation. One source, one contract—will take your plans from first stages through to installation.

Fischer & Porter offers you comprehensive control coverage—the finest standard and miniature instruments for most variables... complete design, engineering and construction facilities for any type of panel or cubicle... experienced technical assistance... *and* data reduction and automation systems.

And F & P complete service costs less, because of the complete handling from beginning to end in one plant.

Use all the advantages of automation. Write, call or wire today for complete information and engineering assistance.



F & P is first with a Data Reduction and Automation Division. Now available is a new digital converter, which provides completely automatic logging from sensing elements to coded or tabulated digital data output.

complete process instrumentation

FISCHER & PORTER CO.

5486 County Line Road, Hatboro, Penn.

FP

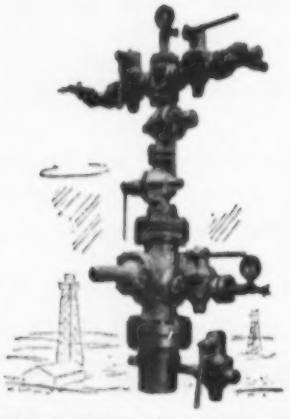
Measuring, Recording, and controlling instruments—Control Panels—Data Reduction Systems—Contract Instrumentation Research—Chlorination Equipment—Glass Specialties.

LA-1004

For more data on advertised products, use Readers' Service Cards, last page.

Goetze V-Tite Gasket being installed on flange of new Space Saver Blowout Preventer, designed and manufactured by Cameron Iron Works, Inc., Houston, Texas.

Goetze Gaskets safeguard critical points under severe pressures



Christmas Tree made by Cameron Iron Works, Inc., is equipped with Goetze V-Tite gaskets to provide safe, tight sealing for every joint.

The new "Space Saver" Blowout Preventer made by Cameron Iron Works, Inc., of Houston, Texas, weighs only half as much as earlier equipment and takes only one-half the space. This improved design permits rig platforms to be smaller, makes possible savings on handling and materials.

For this new equipment Cameron chose Goetze V-Tite Gaskets to do the critical job of sealing Ring-Joint flanges. These precision-made gaskets withstand the high pressures encountered in oil and gas production. Goetze V-Tite Gaskets are fabricated to extremely close tolerances to secure perfect matching of rings with flange joints. They are carefully heat-treated to keep hardness below the maximum allowable. This assures proper flow of the gasket without damage to flange surfaces and reduces the necessity for undue bolt stresses.

Both standard cross-sectional shapes, the oval (Style 950) and octagonal (Style 951), seal tightly at low bolt stresses. Made to ASA-API standards, they are supplied in metals and alloys offering maximum resistance to service and temperature conditions. In addition to the ASA-API sizes, special sizes ranging from one inch to seven feet pitch diameter are available. Catalog PK-35A gives details, sizes and engineering data. Write for it to Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville GOETZE GASKETS

IT WORKS WONDERS IN MATERIALS HANDLING-

300 to 400% increase in efficiency

75% decrease in handling costs

One Truck-Mounted
Dempster-Dumpster Handles Scores
of Containers... All Designs... All Sizes

With the Dempster-Dumpster System, one truck-mounted Dempster-Dumpster accomplishes more than several conventional dump trucks. You eliminate trucks standing idle. You eliminate re-handling of materials. You eliminate loading crews. You increase efficiency, sanitation and good plantkeeping with this Dempster-Dumpster System—the lowest cost method of bulk materials handling ever devised.

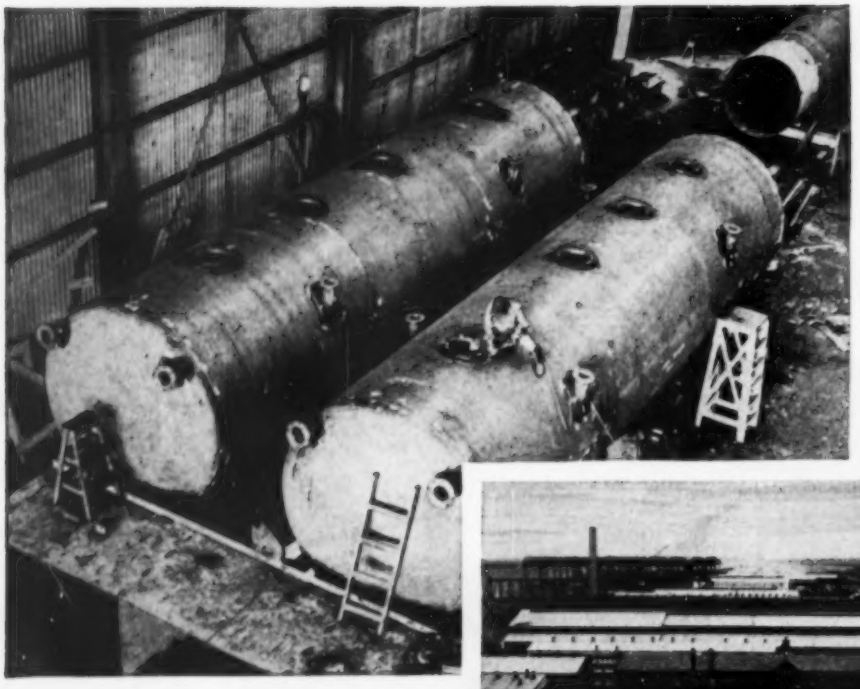
It's like having one truck with scores of bodies. One truck-mounted Dempster-Dumpster serves scores of detachable containers built in capacities up to 15 cu. yds. Each is designed to suit the materials to be handled—be they solids, liquids, dust, bulky, light or heavy. You simply place these containers at convenient materials accumulation points outside or inside buildings. As each is loaded, it is picked up, hauled and dumped (or load set down intact). Entire operation is handled by hydraulic controls in cab by only one man, the driver.

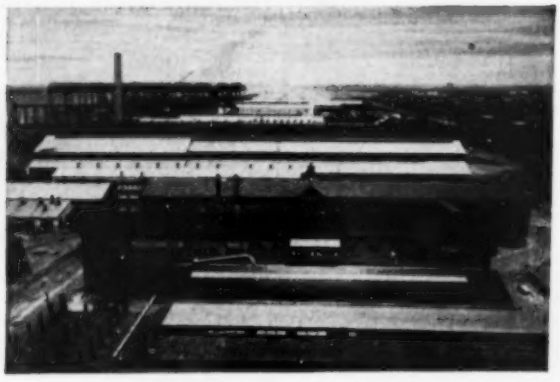
The list of manufacturers using the Dempster-Dumpster equipment reads like the "Who's Who Among the Nation's Leading Manufacturers". We mention this simply to point out that dozens of the nation's oldest and most successful firms use the Dempster-Dumpster System because of its efficiency and tremendous savings. Write to us now for complete information. Manufactured exclusively by Dempster Brothers, Inc.

Representatives in principal cities throughout the United States, Canada and foreign countries. There's one near by to serve you promptly.

DEMPSTER BROTHERS, 584 Dempster Bldg., Knoxville 17, Tennessee

For more data on advertised products, use Readers' Service Cards, last page.





A Mile of Shops – Each shop is devoted to a special type of heavy production. Included are complete Machine Shops, casting, forging and other facilities which offer all of the advantages of the execution of the complete job.

A half mile of pressure vessels

These are two of seventy – over ½ mile – of 38½-foot vacuum tank casings built to meet the quality requirements of a well-known processor.

The buyer also benefits from many savings made possible by Newport News extensive heavy fabrication equipment and the sixty years experience in using it.

Do you plan installations of heavy production equipment? You can command the services of Newport News for weldments of corrosion-resistant, alloy and clad metals in almost any size or shape, plus the required engineering background and complete welding and stress-relieving skills.

It will pay you to get the facts, shown in *Facilities and Products.* As you glance at its photos and brief captions, you'll see why Newport News can turn out – at low cost – specialized heavy equipment for process plants.

Send for *Facilities and Products* – free – today.

Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

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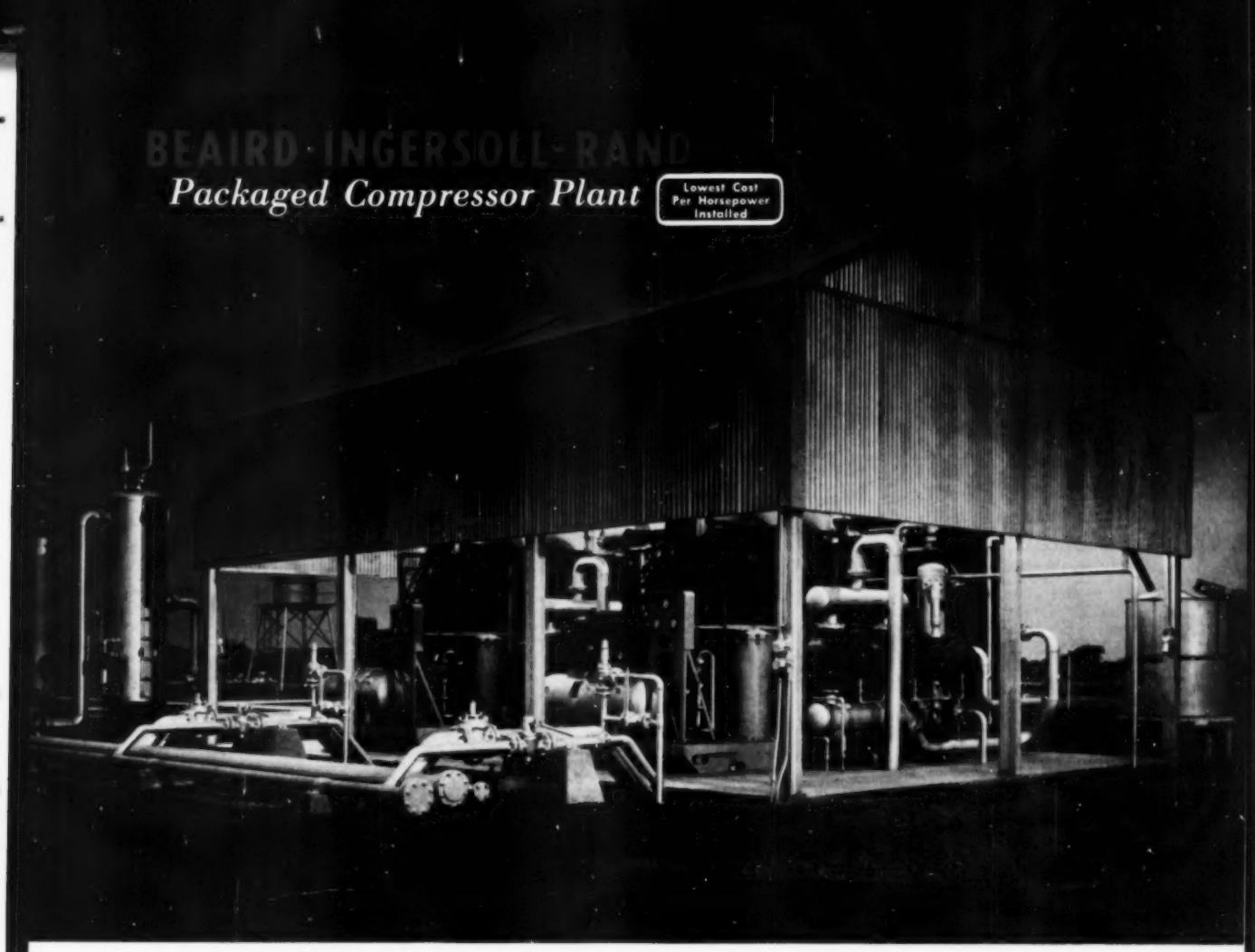
BEAIRD-INGERSOLL-RAND

Packaged Compressor Plant

Lowest Cost Per Horsepower Installed



This packaged compressor plant is complete with two Beaird-Ingersoll-Rand 6SVG, 320 h.p. gas engine driven compressors, Young radiators and all necessary equipment and controls. Other sizes from 110 h.p. to 660 h.p.

Operating Profits Increased —

PACKAGED COMPRESSORS OPERATE GAS LIFT . . . CONSERVE FLARE GAS

SEABOARD OIL COMPANY designed their Plymouth compressor station to meet rapidly increasing gas lift requirements and to convert to profits 1,500,000 cubic feet of gas being flared daily.

With an eye toward future development of the field two Beaird-Ingersoll-Rand packaged compressors were installed. These units have a combined capacity of 3,140,000 Std. cu. ft. of gas per day when operating with suction at a constant pressure of 28 psig and discharging at 750 psig. Necessary controls are incorporated in the design to operate at discharge pressures ranging from 750 psig to 1000 psig. There is ample capacity for gas lifting and the delivery of excess gas into the sales line.

Designed into Beaird's flexible packaged compressor is an automatic speed control to adjust for variations in the rates of gas production. The #1 unit is operated at constant speed while the speed of the #2 unit is automatically increased or decreased to maintain a constant suction pressure.

A plus feature of the Plymouth station is its automatic operation. Built-in controls guard the plant day and night against sudden changes in operating conditions. The entire installation has required no additional personnel.

Beaird packaged compressor plants are also adaptable to gas boosting, repressuring, air compression, refrigeration, pipeline testing and other services in the field where gas is compressed.

Let us show you how a Beaird-Ingersoll-Rand packaged compressor plant can be designed to meet your requirements.

THE J. B. BEAIRD COMPANY, INC.

Shreveport, Louisiana

BEAIRD

MACHINING MANUFACTURING STEEL WAREHOUSE

PACKAGED COMPRESSOR PLANTS

CAST STEEL FITTINGS

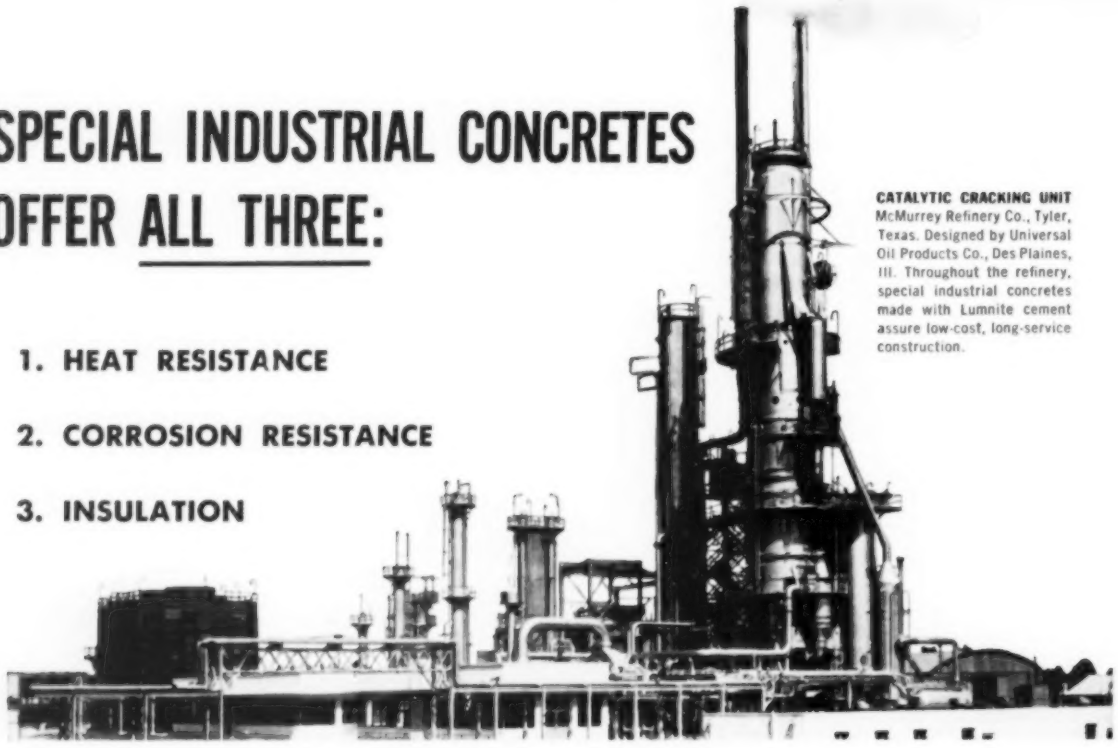
PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP-GAS SYSTEMS

SPECIAL INDUSTRIAL CONCRETES OFFER ALL THREE:

1. HEAT RESISTANCE
2. CORROSION RESISTANCE
3. INSULATION



CATALYTIC CRACKING UNIT McMurrey Refinery Co., Tyler, Texas. Designed by Universal Oil Products Co., Des Plaines, Ill. Throughout the refinery, special industrial concretes made with Lumnite cement assure low-cost, long-service construction.

• Special industrial concretes made with Lumnite* calcium-aluminate cement are actually three-in-one concretes, because they can resist heat and corrosion and *insulate at the same time.* That means you can now use fast, economical industrial concrete in many ways throughout the refinery.

All these concretes are readily made to meet your specific problems of temperatures up to 2600°F. . . . corrosion . . . or special insulating needs.

Best of all, industrial concretes save you money, because construction time and production losses are kept to a minimum. Installation is quick – just trowel or pour into place, or shoot with a cement "gun." Concrete made with Lumnite reaches service strength in 24 hours or less.

For convenient maintenance you may prefer to use prepared castables (packaged mixes of Lumnite cement and selected aggregates for specific temperature and insulation needs – add only water). They're made and distributed by refractory manufacturers. For more information write Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York City 17, New York.

WHERE TO USE SPECIAL INDUSTRIAL CONCRETES

- Tank linings and pipe linings for protection from sour crude
- Linings of reactors; fractionating columns, cracking, distillation, vaporizing and alkylation units; stripper and flash towers; accumulators and soakers
- In furnaces, heaters and coking ovens
- In ducts and furnace foundations
- Stack and flue linings

"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

UNITED STATES STEEL HOUR—Televised alternate weeks—See your newspaper for time and station.

What POLICYHOLDERS *Say*

This is one of many testimonial letters received from policyholders of the Texas Employers Insurance Association. These letters tell what policyholders think of the Service and Savings received from the Association.

Ask the Texas Employers representative nearest you to show you more of these letters, as proof of what Texas' largest writer of Workmen's Compensation Insurance can do for you.

40TH ANNIVERSARY 1914 1954

WE QUOTE FROM A POLICYHOLDER'S LETTER

"We wish to acknowledge with thanks the dividend check you recently delivered to us. Our cash dividend amounted to $1,891.62 and with the Guaranteed Discount of $459.88 made our total savings $2,351.50 on Workmen's Compensation premium paid.

"We now realize more than ever the value of a real safety program. Not only have we brought our experience rate down from a 5.3% debit to a 17.7% credit, but on top of this we have received back from you 33.2% of the premium actually paid.

"We want to thank both your Safety Engineering and Claims Departments for working so closely with us in accident prevention and claim handling."

Largest Writer of WORKMEN'S COMPENSATION INSURANCE *in Texas*

HOMER R. MITCHELL, *Chairman of the Board* A. F. ALLEN, *President*

Service Offices: ABILENE • AMARILLO • AUSTIN • BEAUMONT • CORPUS CHRISTI • DALLAS • EL PASO FORT WORTH • FREEPORT • GALVESTON • HARLINGEN • HOUSTON • LUBBOCK • MIDLAND ODESSA • PORT ARTHUR • SAN ANGELO • SAN ANTONIO • SHERMAN • TYLER • WACO • WICHITA FALLS

TEXAS EMPLOYERS INSURANCE ASSOCIATION
HOME OFFICE - DALLAS, TEXAS

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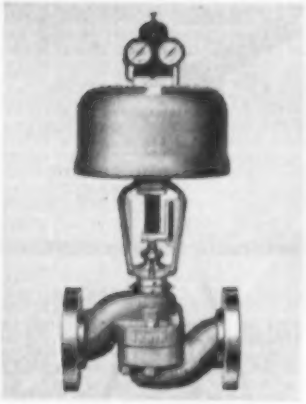
SEE THEM!



Model 1560

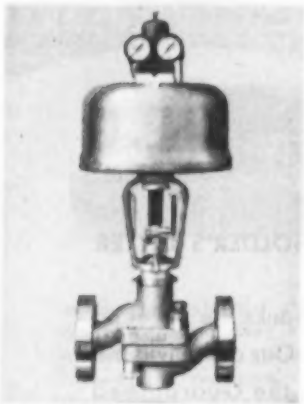
BOOTHS 659 & 661
ISA EXHIBIT
PHILADELPHIA
Sept. 13th thru 24th

Model 3460

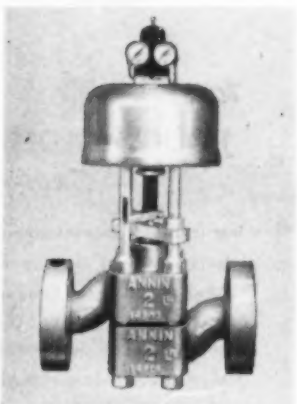
Only

ANNIN SINGLE SEAT DOMOTOR VALVES MEET ALL CONTROL VALVE REQUIREMENTS

SIZES – CV .000001 to 1000
LINE SIZES – ½" thru 10"
BODY RATINGS – Standard 150, 300, 400, 600, 900, 1500, 2500 PSI. Others to 50,000 PSI.
BODY DESIGN – Globe, angle and three-way. Tight shut-off, single seat body. Free-flowing design eliminates erosion. Doolseal, Bellows seal, cooling fin interchangeable with standard bonnet. Optional Teflon guide bushings and Teflon seat seal.
OPERATORS – Domotor, Cylinder and Handwheel. Precise positioning Domotor operators for all pressures and pressure drops. Stroke ranges .005 to 6 inches. Piston sizes of 25, 50, 100, 200 and 400 sq. ins. for thrusts up to 40,000 lbs.

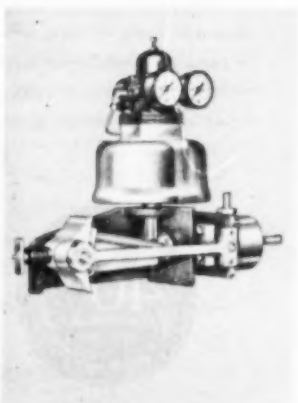


Model 2560



Model 3560

Catalyst Slide Valve



Model 5060

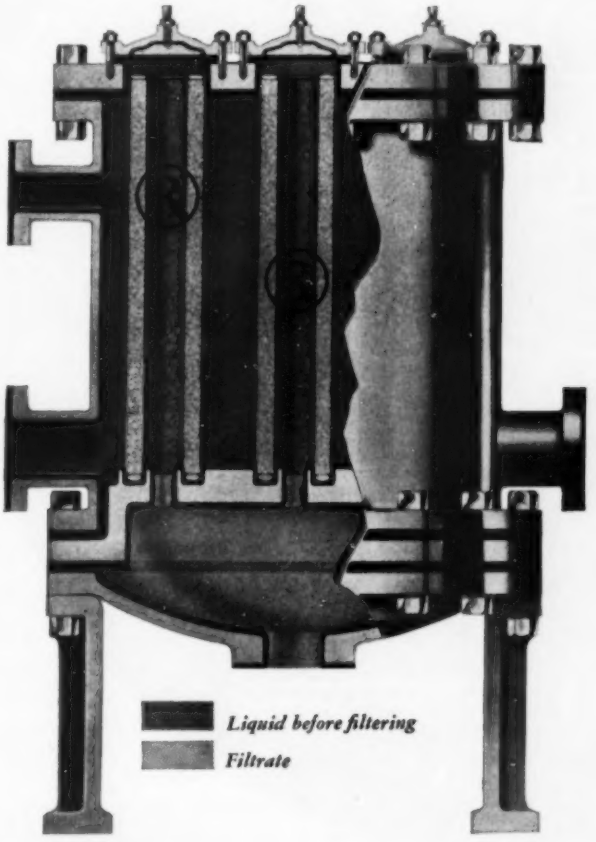
ANNIN Control VALVES

THE ANNIN COMPANY
6570 E. TELEGRAPH ROAD, LOS ANGELES 22, CALIFORNIA

Write today for illustrated catalog 1500B
You'll profit by learning more about the superior features and better performance of Annin Control Valves

Another Norton **℞ *on the job!***

Outstanding performance of Adams filters aided by Norton seamless porous tubes



R. P. Adams Co. Filters, covering many chemical filtering services, deliver sparkling clear filtrate and insure quick cleaning without disassembly. Adams filters handling acid or neutral solutions are equipped with Norton seamless porous tubes, *engineered and prescribed* for faster, more thorough filtering and backwashing.

Besides assuring fast, thorough filtering action, Norton porous tubes are extremely easy to clean by backwashing. Here are several good reasons why they excel in these two primary essentials of efficient, economical filter performance:

- Norton porous tubes are made of ALUNDUM® (fused alumina) *engineered* by Norton for chemical stability, inertness and other properties necessary to withstand acid, neutral and slightly alkaline liquors.
- Like all Norton ALUNDUM porous mediums they are made with the patented *controlled structure* process that assures even distribution of pores — for uniform passage of both filtering and backwashing liquids.
- They are *seamless,* providing unobstructed diffusion over their entire area — for further efficiency in both filtering and cleaning.

Other big advantages

of all Norton porous mediums include ease of installation and exceptional resistance to breakage and chipping. Available in sizes and open-pore ratios to meet your needs, they're *engineered* to last longer and cut your operating costs — and they're *prescribed* for a wide variety of chemical services, such as filtering water or solvents . . . cutting oils, wine, etc. . . . reclaiming cleaning fluids and industrial waste . . . and for boiler feed water treatment.

See your Norton Representative for further facts or write, describing your requirements, to NORTON COMPANY, 49 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

NORTON

REFRACTORIES

Engineered... ℞ ...Prescribed

Making better products... to make other products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

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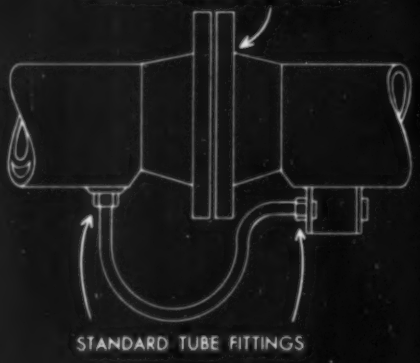
UNITRACE



Possible method of joining UNITRACE using both jumper and welding fittings.

Cross-section view of UNITRACE. Crescent-shaped section at bottom is steam line. UNITRACE is extruded as a single unit from either 3S-F or 63S-T5 Alcoa Aluminum alloys.

ALCOA'S NEW STEAM TRACED PIPE SAVES

30% OF LABOR COSTS

REDUCES MATERIAL COSTS

REDUCES INSULATION COSTS

OVER CONVENTIONAL STEAM JACKETED LINES

Here's a totally *new* product for users of steam traced piping. ALCOA's UNITRACE® *eliminates* the cost of external steam jackets or steam tracer tubes because the steam line is an integral part of the aluminum pipe!

Because of the natural corrosion-resistance of aluminum, UNITRACE is well suited for handling naval stores, molten sulphur, ammonium nitrate solutions, glacial acetic acid, fatty acids, tar, pitch and similar products normally requiring steam tracing.

UNITRACE provides greatly improved heat transfer properties . . . lends itself readily to shop fabrication of standard lengths . . . can be formed easily with tube bending tools. Pre-formed insulation will fit UNITRACE, but improved efficiency makes thermal insulation unnecessary in many cases. UNITRACE is available in 2 inch standard schedule 40 pipe size, and is expected soon to be available in 3 and 4 inch pipe sizes.

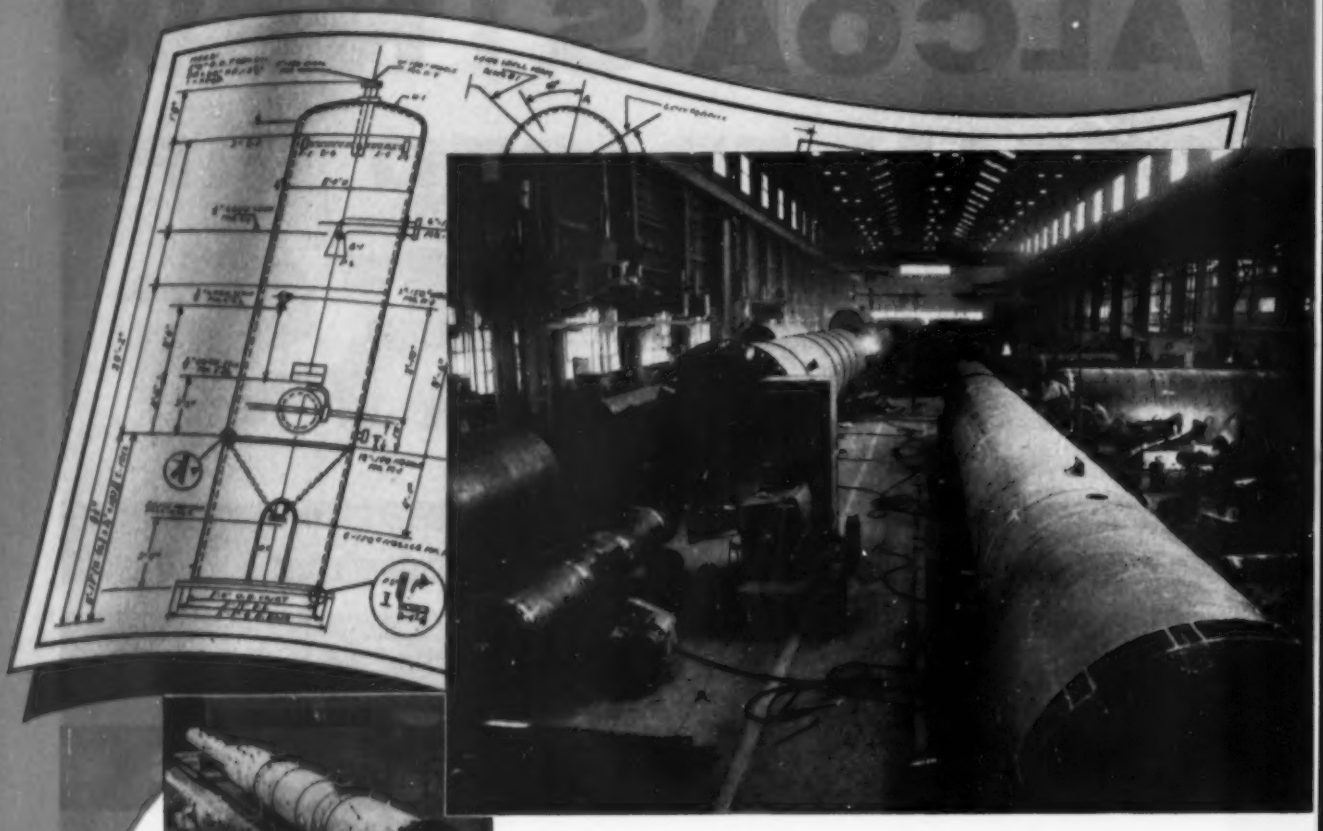
Write today for FREE FOLDER ON UNITRACE, or call ALUMINUM COMPANY OF AMERICA, 905-H Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

For more data on advertised products, use Readers' Service Cards, last page.

You DESIGN 'Em...We'll BUILD 'Em...



And Deliver 'Em To Your Plant Site Ready For Erection and Installation!

Today's Oil and Gas Processing Industries are demanding ever bigger and more complicated processing equipment and facilities to enable them to meet the challenge of tomorrow's business. A large part of this new equipment must of necessity be custom designed, engineered and fabricated because of its tremendous size, its limited application or its special purpose. Such is true of tanks and pressure vessels.

BS&B, with some of the largest and most modern custom fabrication facilities west of the Mississippi River, has become known as one of the industry's leading quality fabricators of custom equipment.

In our Oklahoma City plant, for instance, we are equipped to do automatic and semi-automatic submerged arc, automatic and semi-automatic inert-gas-shielded arc, manual arc and gas welding to conform to all recognized code requirements, and can fabricate plate thicknesses from 14 gauge through 4½".

Our well-equipped machine shops can fabricate both ferrous and non-ferrous alloys, solid and clad materials. In our 2300° F. annealing oven we can stress-relieve units measuring up to 80'-0" in length, 15'-8" in diameter and weighing up to 125 tons. The very latest in quality control, inspection and testing techniques and equipment are in constant use throughout.

Take advantage of BS&B's conveniently located modern facilities and years of fabricating experience on your next project! Our representatives will be glad to discuss it with you in strictest confidence. Or write to . . .

Contract Sales Division, Dept. 5-F8

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

BLACK, SIVALLS & BRYSON, INC.

2131 Westwood Blvd. P. O. Box 1714 Oklahoma City, Oklahoma

—to protect the quality of your gasoline

On-the-spot technical assistance helps you take full advantage of Tenamene

Inhibitor response is closely tied to many variables. These include the nature of the crude, the character of the stock fed to cracking units, operating conditions, equipment performance —even employee carelessness.

Proper and economical use of inhibitors depends on quick adjustments to these changing conditions. On-the-spot service often is a "must."

As the producer of the Tenamene additives, Eastman is ready with that service whenever and wherever you need it. Highly qualified men are less than 24 hours away, ready to make your refinery their headquarters whenever a problem arises.

For more information on Tenamene additives and the interested technical service that backs up their proper use, contact our local representative or write to Eastman Chemical Products, Inc., Kingsport, Tennessee—a subsidiary of Eastman Kodak Company.

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tenn.; New York—260 Madison Ave.; Framingham, Mass.—65 Concord St.; Cincinnati—Carew Tower; Cleveland—Terminal Tower Bldg.; Chicago—360 N. Michigan Ave.; St. Louis—Continental Bldg.; Houston—412 Main St. **West Coast: Wilson Meyer Co.;** San Francisco—333 Montgomery St.; Los Angeles—4800 District Blvd.; Portland—520 S. W. Sixth Ave.; Seattle—821 Second Ave.

Tenamene

EASTMAN GASOLINE ADDITIVES

For more data on advertised products, use Readers' Service Cards, last page.

TESTING OF CUTTING FLUIDS *utilizes an* ***ElectroniK*** *temperature recorder to chart the heating of work and tool on lathe, during cutting operations with different cutting oils.*

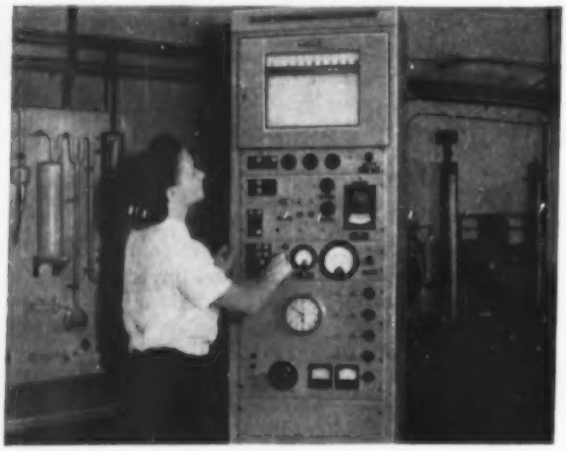
Automation-

with

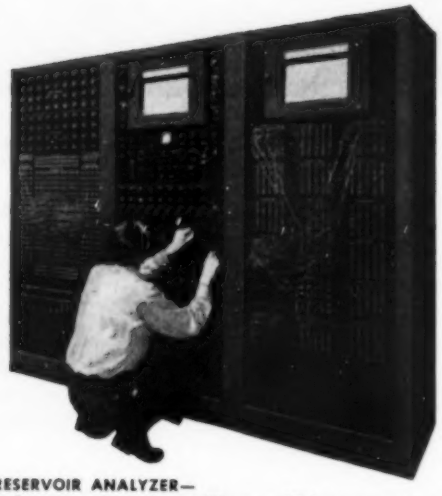
ElectroniK

instruments . . .

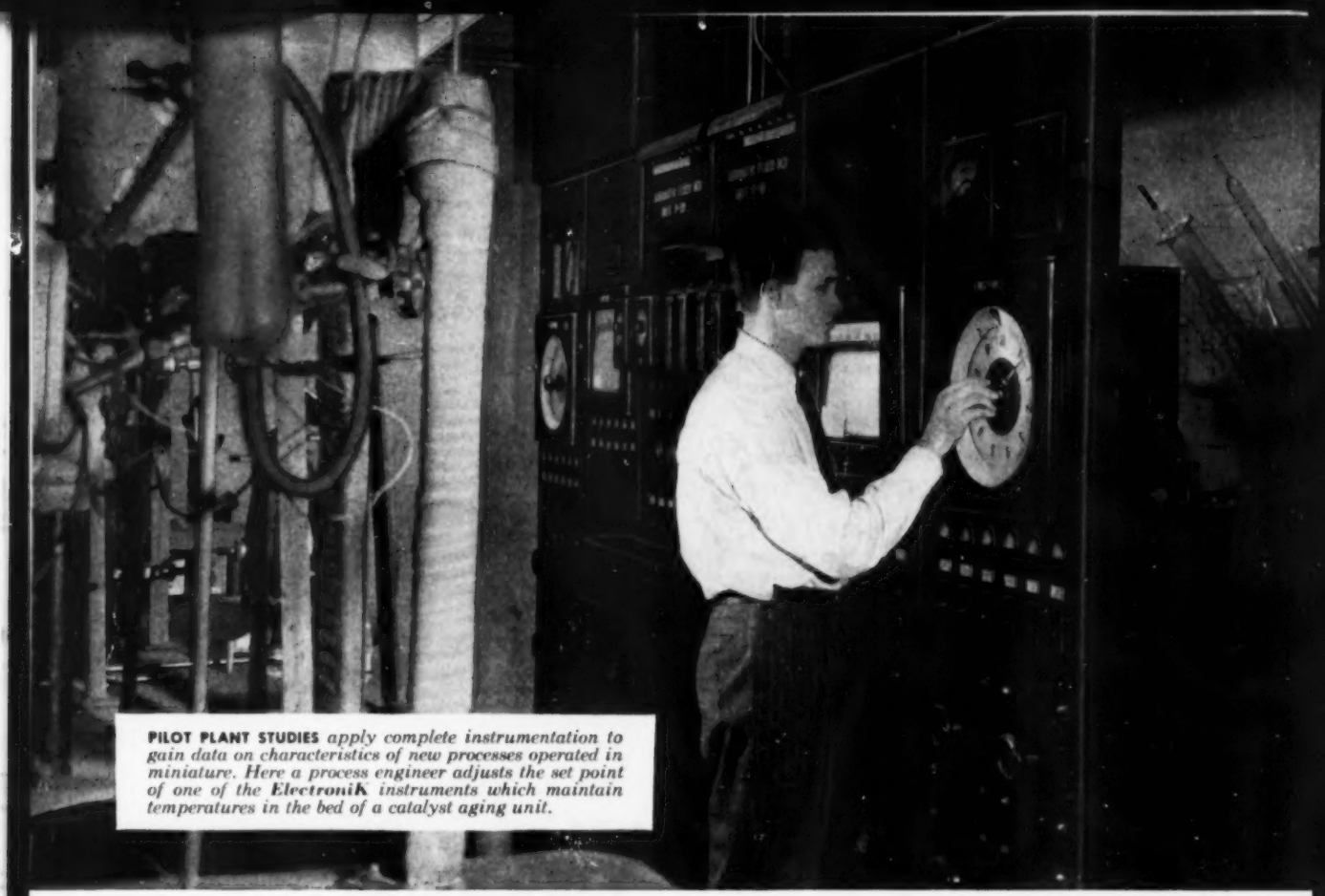
ENGINE PERFORMANCE *with various fuels and oils is measured with these* ***ElectroniK*** *instruments in a sound-proof room in the Automotive Oil and Gasoline Testing Laboratory.*



ELECTROCHEMICAL ANALYSIS *of several different types is readily accomplished with this laboratory-built apparatus. Amperometric, polarographic and potentiometric titrations are recorded on an* ***ElectroniK*** *instrument.*



OIL RESERVOIR ANALYZER— *an analog computer using an* ***ElectroniK*** *instrument to record results—is used for studying the production of oil wells, and for predicting the need for well-stimulating action.*



PILOT PLANT STUDIES *apply complete instrumentation to gain data on characteristics of new processes operated in miniature. Here a process engineer adjusts the set point of one of the ElectroniK instruments which maintain temperatures in the bed of a catalyst aging unit.*

. accelerates Gulf Oil's research

RESEARCH MEN, as well as production men, find that modern Honeywell instrumentation can help them to function more efficiently. The examples shown here at the laboratories of the Gulf Research & Development Company are typical of the ways that these instruments save busy scientists countless man-hours of routine work.

Observing tests . . . writing down figures . . . drawing curves of results . . . these and many other laborious tasks that used to take up the research man's time can now be performed automatically by *ElectroniK* instruments. In many respects, the "automatic laboratory" is closer to reality than the automatic factory. For, through the use of *ElectroniK* instruments, many tests which formerly needed constant supervision can now run practically unattended . . . data is being accumulated at an accelerated pace . . . valuable personnel are being utilized more effectively.

As you can see by glancing through the applications pictured, the field for instrumentation is as broad as a research man's imagination. Often, standard *ElectroniK* models fill the requirements. And for the specialized needs of pilot plants and basic investigations, there are numerous modifications of this versatile instrument—such as the Function Plotter, the Duplex Recorder, the ½ Second Pen Speed Recorder, the Precision Indicator, and the High Impedance Recorder.

Your nearby Honeywell sales engineer will be glad to discuss applications in your own research activities . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Catalog 1521 "*ElectroniK* Recorders", and for Data Sheets on specific research application.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

CHASE

PIN-POINTING TROUBLE BEFORE IT STARTS!

By expanding Antimonial Admiralty Heat Exchanger Tubes over a tapered pin in the laboratory, Chase metallurgists check the ability of the tube to withstand expanding and flaring operations during installation.

Another reason why

Chase®

Antimonial Admiralty Heat Exchanger Tubes last longer!

For heat exchanger tubes that stay on the job year in, year out, insist on Chase Antimonial Admiralty.

What's the secret? *Enough* antimony to resist dezincification effectively. Does antimony adversely affect the strength or other properties of admiralty? Definitely not! The antimony imparts corrosion resistance which assures long life under many different water conditions.

So, whether you're replacing heat exchanger tubes, or planning a new installation, specify Chase Antimonial Admiralty!

CHASE WAREHOUSE STOCKS: New Orleans, Los Angeles. Also carried by Vinson Supply Co., Tulsa; Standard Brass & Mfg. Co., Houston.

Chase® BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver†	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston	Newark	Rochester†	(†sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	

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Like to have a picture story of this petro-chemical plant?

Write for this booklet today!

Here's a brochure that's almost as good as a guided tour through the Tuscola, Illinois plant of National Petro-Chemicals Corporation. It's a picture story, in brochure form, of the design, construction and engineering of one of the world's largest petrochemical plants.

Twenty-four pages of photographs let you see for yourself the complexity of this $50,000,000 installation, for which J. F. Pritchard & Co. was the major contractor.

Your complimentary copy is waiting. Fill out and mail coupon today. No obligation.

FILL OUT COUPON NOW FOR YOUR COPY!

Industry's Partner for Progress

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS

Dept. 423 210 West 10th Street, Kansas City 5, Mo.

CHICAGO • HOUSTON • NEW YORK
PITTSBURGH • ST. LOUIS • TULSA

SERVING THE GAS, POWER, PETROLEUM AND CHEMICAL INDUSTRIES

J. F. Pritchard Co., Dept. 423
210 West 10th Street, Kansas City 5, Mo.

Please send me my complimentary copy of your brochure describing the National Petro-Chemicals Corporation's Tuscola, Ill. plant.

Name _____

Position _____

Firm _____

Address _____

City _____ Zone ____ State _____

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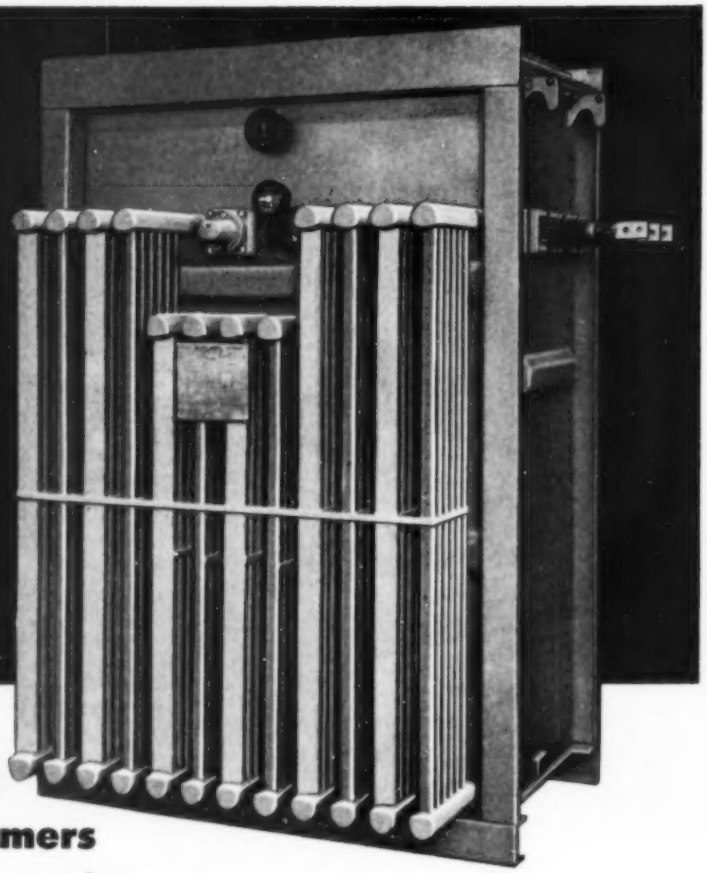
Wagner®
TRANSFORMERS
...the choice of leaders in industry

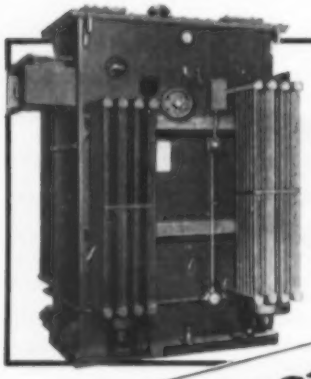
first step to building a compact, modern Unit Substation



THE NEW

Wagner Liquid-Filled Load Center Transformers designed for flush mounting

Now, Wagner Noflamol (non-inflammable liquid-filled) Load Center Transformers are available in a new, improved close-coupled design, as well as in the standard throat-connected design. These transformers can be flush-mounted with any make of switchgear to form a neat, compact, streamlined unit substation for modern industrial service.



Wagner
Throat-Connected Unit Substation Transformers

For outdoor installation, or for applications where it is desirable to locate the transformer away from the switchgear, Wagner can furnish these liquid-filled transformers in ratings to 2000 kva, 15 kv and below. Bulletin TU-13 gives full information.

Wagner close-coupled transformers are available in ratings from 500 through 2000 kva. They are carefully designed to meet your distribution requirements.

Look to Wagner for better transformers that assure a continuous, dependable flow of power. Your nearby Wagner engineer will be glad to help you solve your load-center problems. Call the nearest of our 32 branch offices, or write us.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6458 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

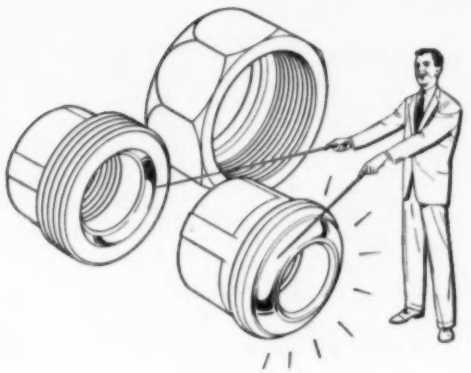
ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

T50-11

Now!

A revolutionary new feature...

Hardness-Differential



built into seats of new Union #603

The first steel Union on the market of this type!

Special heat treating now makes possible the Hardness-Differential you've been wanting. *No other Union has this differential.*

The male seat of the new Rockwood Union #603 is specially heat treated to give it a greater degree of hardness than the female seat.

As a result, you get —

No galling in "making up" — longer service.

You also get —

Seats forged in place and double-locked under 100,000 and 400,000-pound pressure. Both seats are made of corrosion-resistant AIST molychrome steel.

Exclusive Rockwood cold forging process results in higher resistance to tough working conditions, expansion and contraction, shock, jar, vibration. Cold forging also results in absolutely interchangeable parts — pipe fitter won't scratch or damage seat in making up in tight places because of plug type ball-to-cone design — eliminates sharp corners or edges.

Exclusive "Rockwoodizing" — a special Rockwood coating process, applied after threading, protects entire union, including threads against corrosion.

Get the seats with the Hardness-Differential built right in. Mail coupon today.

ROCKWOOD SPRINKLER COMPANY
WORCESTER 5, MASSACHUSETTS

ROCKWOOD

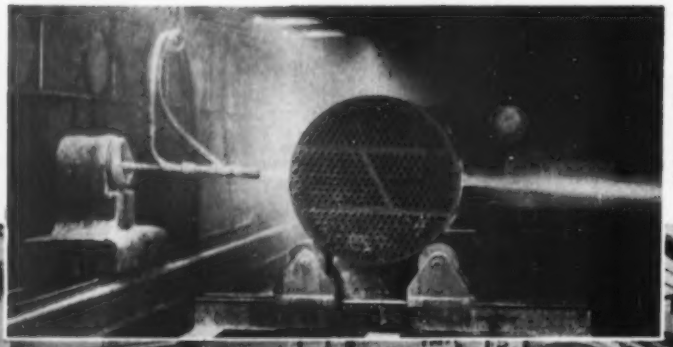
ROCKWOOD SPRINKLER COMPANY
648 Harlow Street
Worcester 5, Mass.

Please send me prices and further data on the new Rockwood Union #603. I would also like the name of the nearest Rockwood distributor.

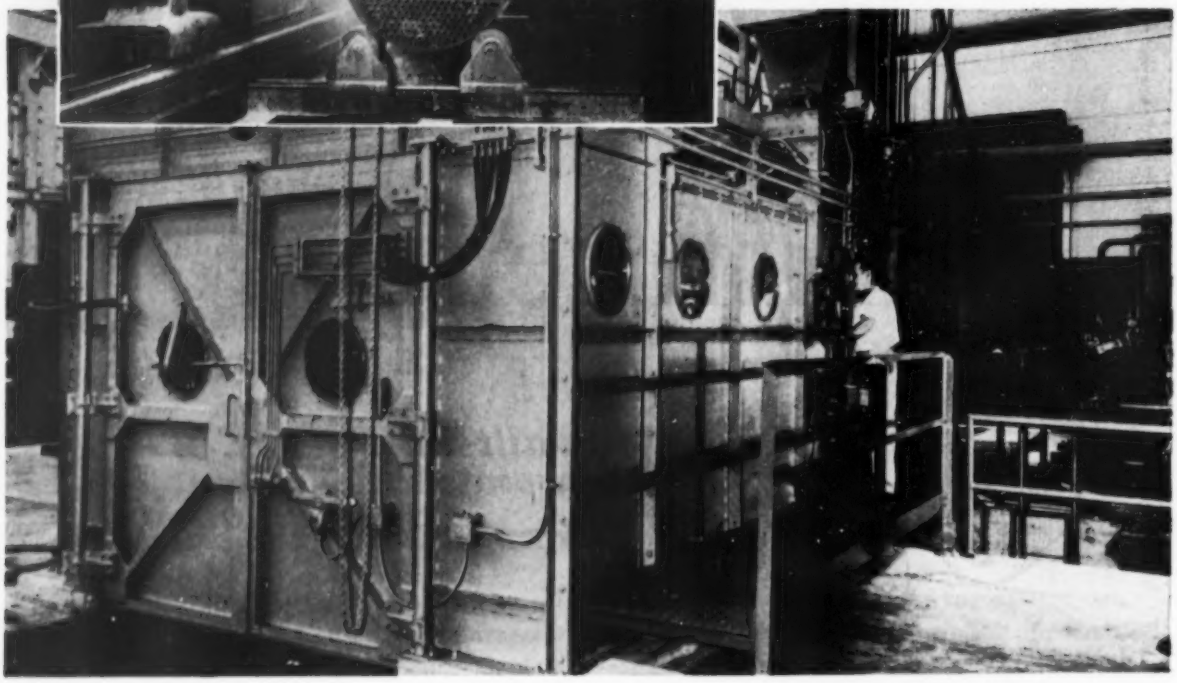
Name .....
Title .....
Company .....
Street .....
City ..... Zone ..... State .....

For more data on advertised products, use Readers' Service Cards, last page.

A NEW and far more efficient method of cleaning HEAT EXCHANGERS



- it effects significant savings in cleaning time
- it does a thorough cleaning job
- it materially promotes operating efficiency



THE WORLD'S FIRST HYDRO-BLAST TUBE BUNDLE CLEANING SERVICE.

Hydro-Blast is a method of sandblasting, using water at 1600 PSI in which sand is entrained. Either square or triangular pitch bundles can be cleaned quickly and efficiently. Both the tube and shell side of the bundle is cleaned. Hydro-Blast combines abrasive cleaning with the mining effect of high velocity water.

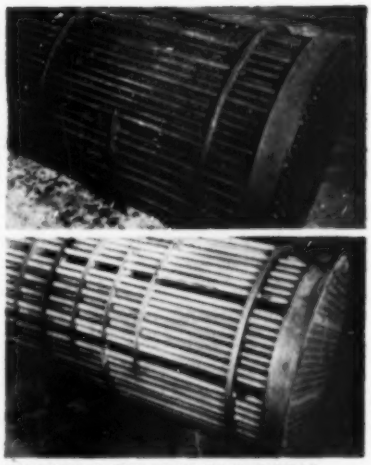
The 60-gpm carriage-mounted gun pictured above is operated to direct a high pressure stream completely through the bundle, cleaning the innermost tubes. Insides of tubes are thoroughly cleaned by mechanically adjusted guns mounted in the end doors of the Hydro-Blast Unit.

For greater exchanger unit efficiency, use our Hydro-Blast Service. **Ohmstede** picks up and delivers.

For service call:

OHMSTEDE MACHINE WORKS

Telephone 4-6376 Beaumont, Texas

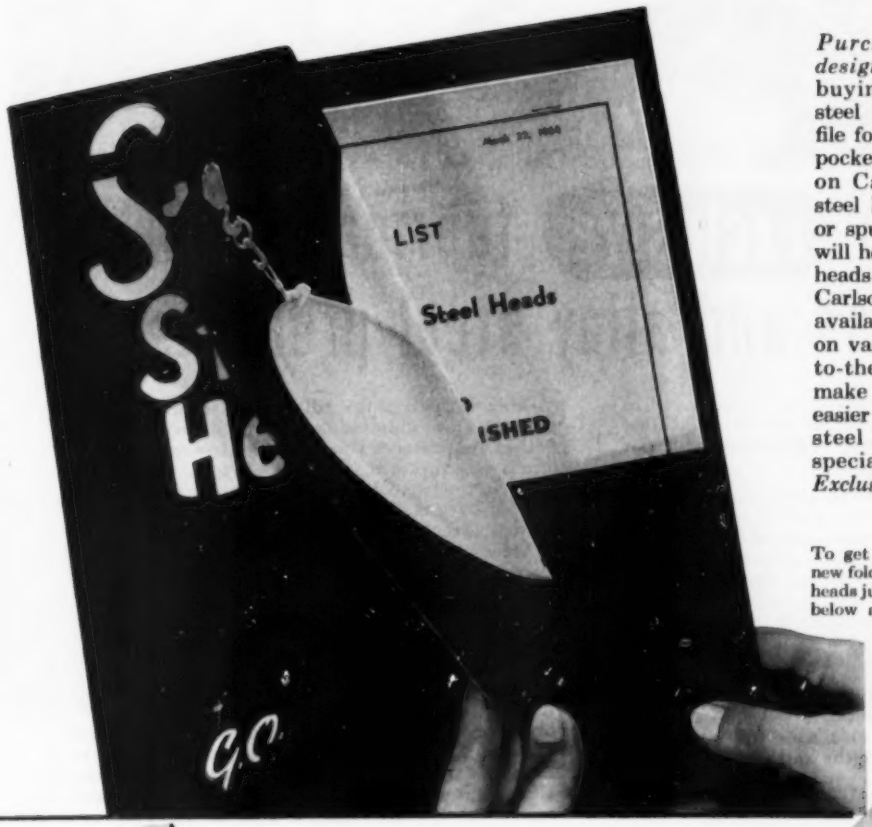


PICTURED IS THE SAME TUBE BUNDLE BEFORE AND AFTER HYDRO-BLAST CLEANING!

For sales write: **OHMSTEDE CO., INC.** P. O. Box 1288, Beaumont, Texas.

get your copy of this new folder on Stainless Steel Heads

...a G. O. CARLSON, INC. 1ST



Purchasing men, engineers, designers, estimators—anyone buying or specifying stainless steel heads will want this new file folder. In its four pages and pocket there's useful information on Carlson-produced stainless steel heads, either press formed or spun. And the handy pocket will hold the latest price lists for heads carried in stock by G. O. Carlson, Inc., plus a list of dies available for forming and data on various head styles. This up-to-the-minute information will make it easier to specify and easier to buy the finest stainless steel heads from a producer, specializing in *Stainless Steels Exclusively.*

To get your copy of this new folder on stainless steel heads just fill in the coupon below and send it along.

Stainless Steels Exclusively

G. O. CARLSON, INC.

Plates • Plate Products • Forgings • Bars • Sheets (No. 1 Finish)

THORNDALE, PENNSYLVANIA

District Sales Offices in Principal Cities

Please send me your new folder on Stainless Steel Heads

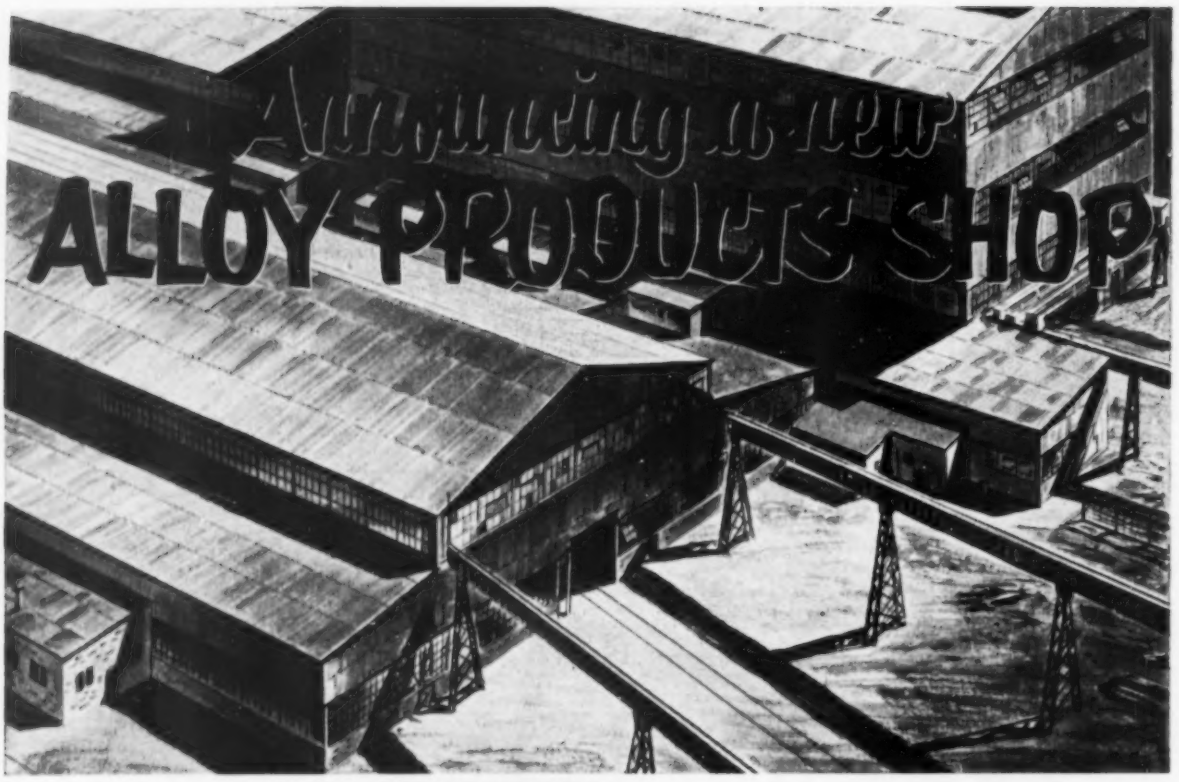
NAME_____

COMPANY NAME_____

STREET_____

CITY_____ STATE_____

For more data on advertised products, use Readers' Service Cards, last page.



for the exclusive fabrication of stainless and alloy steel products

The new plant shown above, now finished and in operation, permits us to fabricate stainless and alloy steels in a shop completely segregated from our carbon steel operations.

Purity is Paramount—From an experience of many years in making *both* carbon and alloy equipment for industry, it has been demonstrated that the ideal set-up is—*segregation*. For top quality it is better that high-grade alloy steels be not exposed to contamination by tools and equipment used to make ordinary carbon steel products.

Sun Ship's new Alloy Products Shop, therefore, marks a distinct step forward in a great and growing field. Chemical plants, oil refineries, atomic energy plants, and many other types of industry are finding more and more uses for equipment boasting the special strengths and virtues contributed only by alloy steels.

Every Size and Type—In this new shop we are working with all of the 300 or 400 series of alloys, clad steels and aluminum; and are fabricating such products as pressure vessels, tanks, towers, troughs, autoclaves, reactors, hoppers, kettles, platework and machinery. All sizes and types are handled; and pieces too long for delivery by rail can be shipped direct by water from our own docks on the Delaware.

Every Facility—The new shop is an integral part of Sun Ship's huge plant at Chester, Pa.—an impressive blend of steel fabricating shops, forge shops, boiler and tank shops, machine shops and every other facility needed for building the many types of made-to-order equipment required for modern industry.

For more specific information about our new Alloy Products Shop, for estimate, advice or a representative's personal call, just get in touch with our Sales Engineering Department. Your inquiry will receive prompt and expert attention.

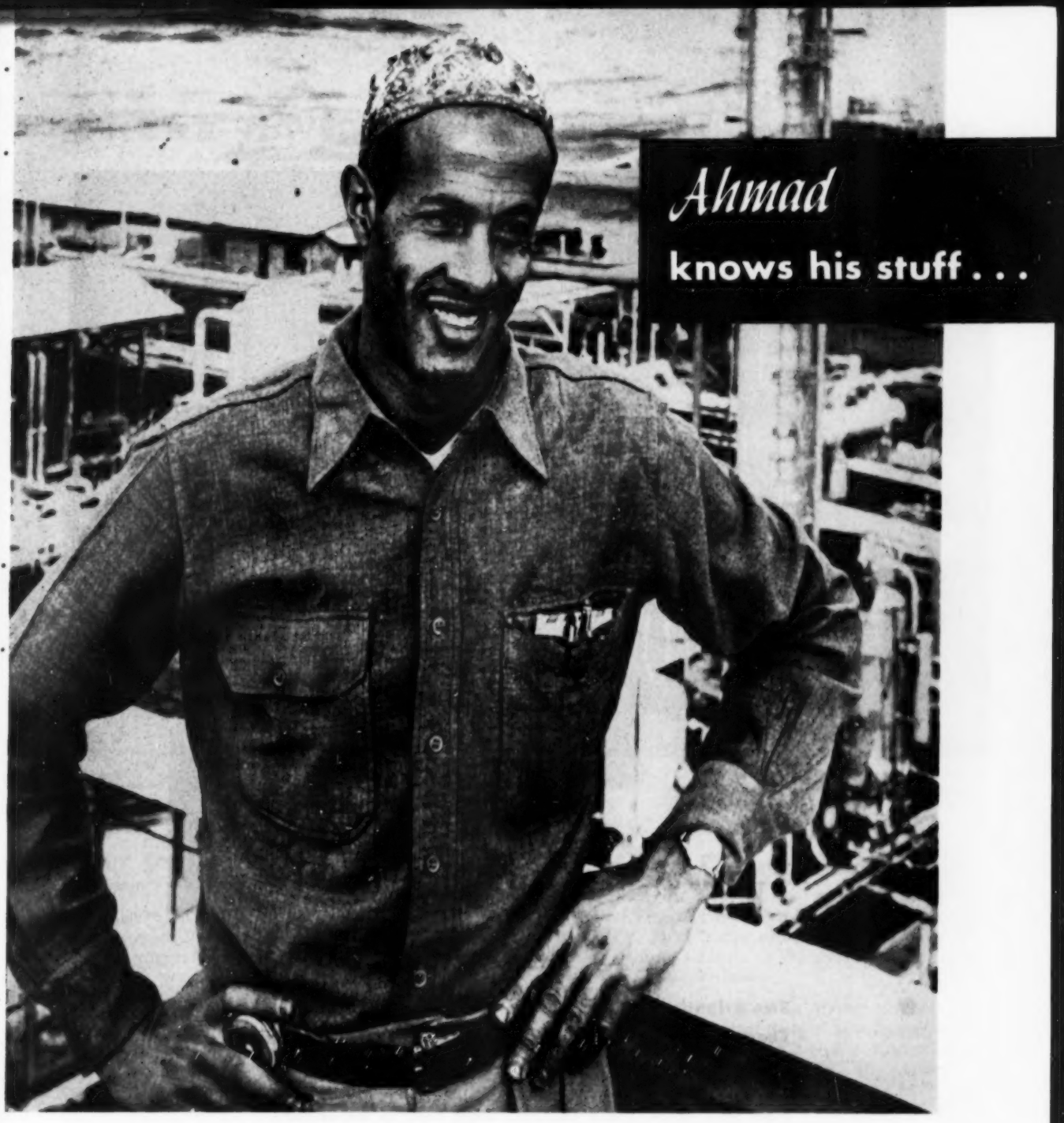
Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE SINCE 1916 **CHESTER, PA.**

25 BROADWAY • NEW YORK CITY

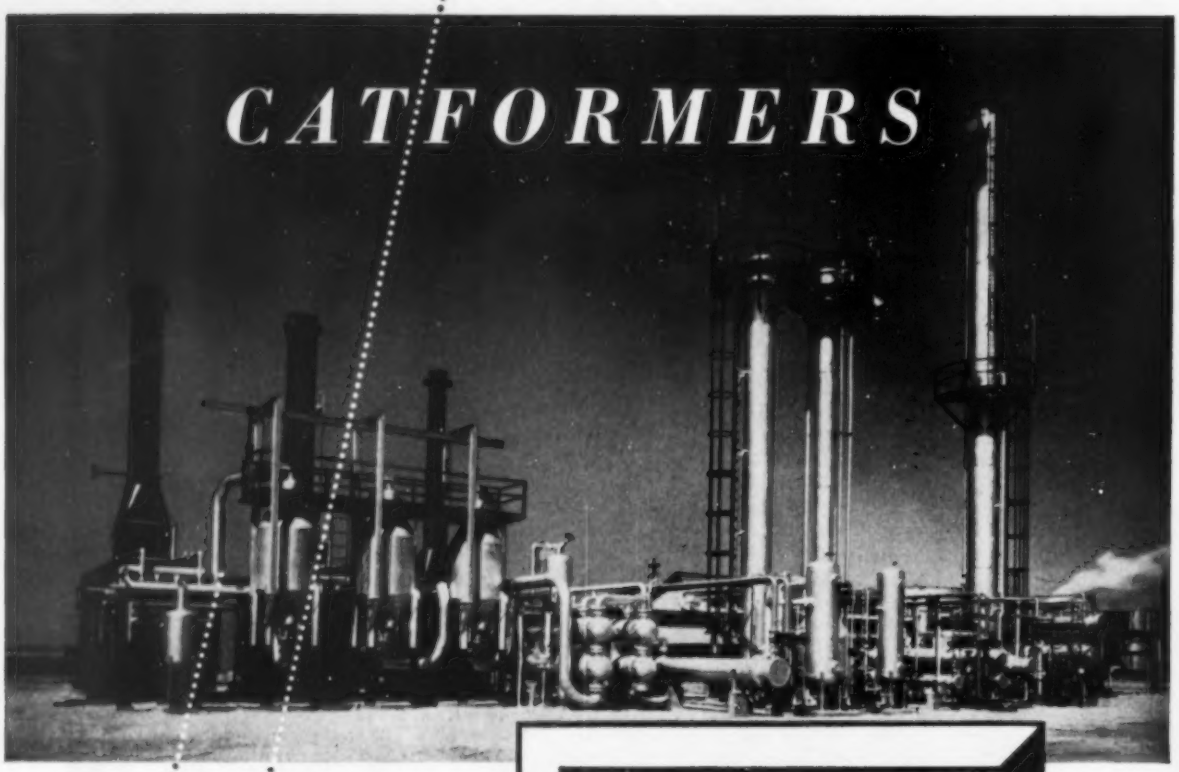
For more data on advertised products, use Readers' Service Cards, last page.



Ahmad Isa al-Masalli is just the man for the instructor's post at the Dhahran stabilizer. He has 14 years of service with the Arabian American Oil Company. Now Ahmad passes on his wealth of technical knowledge to his Saudi Arab countrymen who come to work at the complex stabilizer.

ARABIAN AMERICAN OIL COMPANY
DHAHRAN, SAUDI ARABIA NEW YORK, N. Y., U. S. A.

CATFORMERS



..... by **PARSONS**

Two Atlantic Type Catformers — the first on the Pacific Coast — have been designed and constructed by The Ralph M. Parsons Company.

Now on stream, these facilities were built in Bakersfield, California for DOUGLAS OIL COMPANY OF CALIFORNIA and MOHAWK PETROLEUM CORPORATION.

THE RALPH M. PARSONS COMPANY

Engineers • Constructors

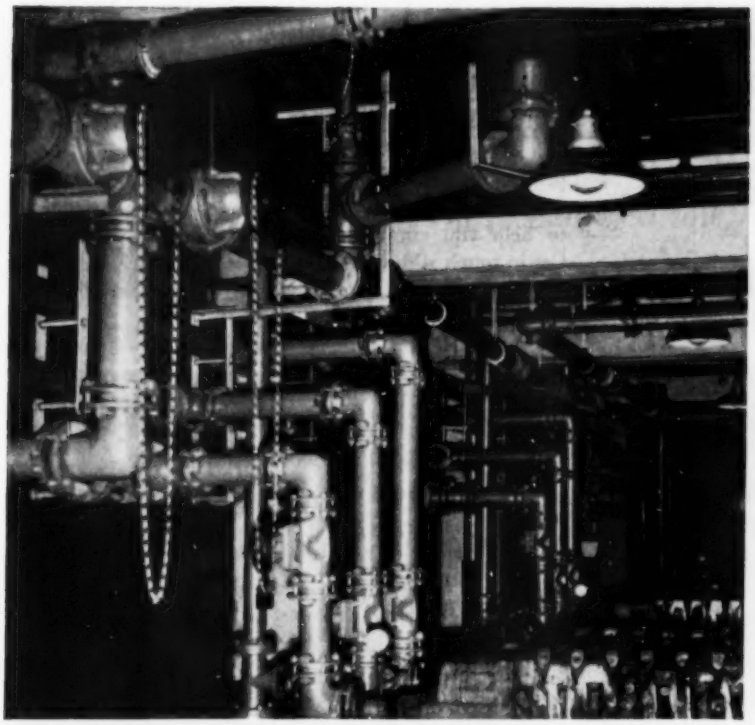
617 South Olive Street, Los Angeles 14, California

NEW YORK • TULSA • WASHINGTON, D. C. • ANKARA • BAGHDAD • KARACHI • PARIS • BEIRUT

WHERE HAVEG EQUIPMENT IS INSTALLED

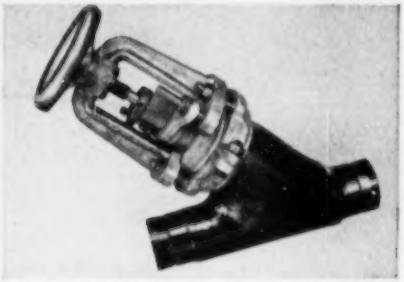
TRADE MARK REG. U. S. PAT. OFF.

PIPE • DUCT • FITTINGS • VALVES • PUMPS



A typical large installation of Haveg pipe, valves and fittings showing simple method of support required. Haveg pipe is unaffected by thermal shock, seldom requires insulation.

These Haveg parts are used in pumps for hot (104°F.) 30% Hydrochloric acid. Typical record: 33 months without replacing a single part. Many users report even longer life.



Escape potential valve troubles by buying Haveg y-valves and diaphragm valves which are smooth-molded, exactingly machined, tested in the Haveg factory. Haveg works with you on special designs!

Processing Corrosion has been Controlled!

Where liquids get hot and corrosive, it pays to consider all the facts about Haveg piping systems. Haveg has all the major ingredients for good chemical piping. Strength. Durability. Light weight. Outstanding resistance to corrosion and thermal shock.

It withstands rapid temperature changes and enables you to go into a high range of process temperatures with complete safety and a proven history of reliable performance. Haveg piping resists corrosion of practically all acids (except oxidizing acids) and lasts for years without repairs or maintenance.

Haveg *piping* is molded in diameters of ½" up and comes in lengths to 10'. It can be cut and fitted on the job (a new Haveg tool makes this even simpler—ask your Haveg engineer for details). For handling corrosive gases or fumes, Haveg *duct* is made in cylindrical or rectangular shape with lighter walls. Fume hoods, bifurcators, fan housings, fittings, all are made from Haveg and give complete containment and control of corrosives.

It's a long story telling all about Haveg, the moldable, thermosetting plastic material made of acid-digested asbestos and synthetic resins. Haveg is both a material and a service . . . it comes from America's first molders of corrosion-resistant plastic equipment. It can be as big as a 200' stack, as small as a miniature pump part. Call the experienced sales engineer listed. Write for the 64-page illustrated Bulletin F-6 which contains size and chemical resistance charts, design specifications. Remember, Haveg is a logical, proven answer to your design problems in handling hot, corrosive liquids; in fact, in all equipment that must control processing corrosion.

ATLANTA, Exchange 3821 • CHICAGO 11, Delaware 7-6088
CINCINNATI 36, Sycamore 2600 • CLEVELAND 20, Washington 1-8700
DETROIT 39, Kenwood 1-1785 • HOUSTON 4, Jackson 6840
LOS ANGELES 14, Mutual 1105 • SEATTLE 7, Hemlock 1351
ST. LOUIS 17, Mission 5-1223 • WESTFIELD, N. J., Westfield 2-7383

HAVEG CORPORATION
NEWARK 4, DELAWARE

TRADE MARK REG. U. S. PAT. OFF.

FACTORY: MARSHALLTON, DEL. • Wilmington 3-8884

A SUBSIDIARY OF CONTINENTAL-DIAMOND FIBRE CO.

For more data on advertised products, use Readers' Service Cards, last page.

6 TANKS CLEANED IN 5 HOURS

Chemical cleaning by DOWELL prepared 216,000-gallon oil tanks for conversion to sulfuric acid storage

A steel company wanted to convert six 216,000-gallon tanks from fuel oil and gasoline storage to sulfuric acid storage. It was necessary to remove oil and tar film from the inside walls and ceilings of these tanks.

Dowell engineers, using special high-pressure hoses and nozzles, sprayed thickened chemical solvents over all internal surfaces from the tank floor. No scaffolding was required. The thickened solvents clung to the tank walls during the cleaning process. The entire surfaces of all six tanks—including seams, rivets and braces—were cleaned in only five hours.

Whatever *your* cleaning problem—pipe lines, boilers, process equipment, water wells—take it to Dowell. Their engineers have the experience, materials and equipment to help you cut cleaning costs—keep up production. Get in touch with the nearest of over 130 offices or write direct to DOWELL INCORPORATED, Tulsa 1, Oklahoma, Dept. H-31.

Dowell engineers prepare solvents based on the type of deposit to be removed. They furnish all necessary pumping and control equipment. And they apply the chemicals according to the technique demanded by the job: filling, spraying, jetting, cascading or vaporizing. Dismantling is held to a minimum.

DOWELL SERVICE

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

For more data on advertised products, use Readers' Service Cards, last page.

The Mail Box . . .

Hay Filters

To The Editor:

You did a good job publishing "Experience with Amine Units" in your June issue. The authors concluded "tentatively" in one paragraph that precoated type filters using diatomaceous filter aid are most satisfactory, after having tested several types of filters.

In this section of Pemex we have two amine units using MEA, and after three years of operating experience we concluded that filters with diatomaceous filter aid were useless. We also "tentatively" concluded that hay filters did a very satisfactory job and are less expensive. Some other MEA plants in the U. S. also use hay filters.

The number of variables makes it almost impossible to reach unquestionable conclusions, unless all are solved. I just want to state that what was all right for five plants was wrong for two others.

Thomas Garcia B.
Chief Chemist
Petroleos Mexicanos
Poza Rica, Ver.

Lists Safety Topics

To The Editor:

First, let me congratulate you on your good judgment in the selection of articles on safety and fire which appear regularly in the PETROLEUM REFINER. Such articles should stimulate the thinking of management as well as operating personnel and should lead to a more cooperative attitude toward the prevention of fires and accidents.

Permit me to suggest articles on the following relative to safety:

1. "Control of Hazards Associated with Maintenance Work on Chemical Pipe Lines."
2. "Control of Hazards Associated with Work in Confined Spaces."

Since the published data on the above subjects is somewhat limited, I believe that a series of articles (covering the subjects in detail) would be of extreme interest to both management and operating personnel.

V. D. Monroe
104½ N. 21st Street
Paducah, Ky.

"Evangel" Likes Article

To The Editor:

Your June, 1954 issue of PETROLEUM REFINER carried an article, "Counsellor Service Program Helps Workers Do Better Jobs." It began on page 217.

Would it be possible for us to get permission to reprint this article in our weekly *Evangel*? We have an industrial chaplaincy division in our Home Missions Department which has been relatively undeveloped and we would like to use this article to help stir interest in this field.

Rev. Charlie Martin is one of our ordained ministers and so we would appreciate the privilege of reprinting this article about him.

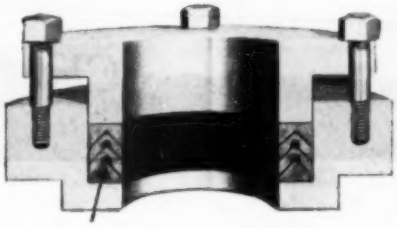
Betty Ackerman
Promotional Supervisor
Home Missions Department
434 W. Pacific Street
Springfield 1, Mo.

Why users prefer

CHEVRON* Packing

for rams, plungers, reciprocating rods

1. *Assures a low friction, positive seal*
2. *Lasts much longer, needs less maintenance than ordinary V-type packing*
3. *Works efficiently in a shallow stuffing box*



Note the exclusive hinge-like construction of CHEVRON packing.

Garlock 431 CHEVRON Packing

GARLOCK CHEVRON Packing is entirely different from ordinary V-type packings. With *increasing* pressures CHEVRON rings tighten and prevent leakage; with *decreasing* pressures the packing eases off and permits operation with a minimum of friction.

Service reports, such as those below, prove that CHEVRON packing seals better and lasts longer.

▶ On hydraulic press—40" ram, 6,000 p.s.i., ram honed and chrome plated, gland machined to give clearance of .006" between gland and ram. Garlock 431 CHEVRON size 40" x 41½" x only 2" deep gave 14 years service.

▶ On a machine with hydraulically operated clutches—¾" cylinder, maximum pressure 500 p.s.i., service intermittent, maximum travel ¾". First used cups, then "O" rings, neither of which worked well. Now packed with Garlock 431 CHEVRON ⅜" x ¾" x 1⅛" deep and doing a smooth, positive sealing job.

Ask your Garlock representative to give you all the cost-saving facts about CHEVRON packing, or write for folder AD-115.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N.Y.) • Philadelphia Pittsburgh • Portland (Ore.) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

*Registered Trademark

GARLOCK

PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS
RUBBER EXPANSION JOINTS

For more data on advertised products, use Readers' Service Cards, last page.

New Grease Thickener...

Estersil GT

by Du Pont

A new type of grease thickener—quite different from any previously used in commercial grease production—was recently announced by the Petroleum Chemicals Division of the Du Pont Company.

The new material, an estersil, is a pelletized form of finely divided amorphous silica with a "raincoat" chemically attached to each tiny ultimate particle.

Formerly known as PL-171 FINE SILICA, it is completely synthetic and was specially developed for grease compounding. "Built-in" water resistance and exceptional thermal stability are among its unusual and outstanding properties.

NOW—with Estersil GT you can easily prepare a unique multi-purpose grease with the basic advantages listed below . . .

Du Pon
new
for
a
of
t

Du Pont Petroleum Ch

1. Excellent Thermal Stability—Nonmelting Estersil GT greases show little change in consistency over a wide range of operating temperatures.

2. Excellent Shear Stability—This new thickener enables you to make greases with exceptional shear stability under *both* normal and *high* temperature conditions.

3. Water Resistance—The chemically bonded "raincoat" means greases with unusual resistance to wash out or break down in the presence of water.

4. Superior Oxidation Stability—The need for grease antioxidants is eliminated under most service conditions because of the inertness of Estersil GT.

5. Superior Handling Qualities—Softer, more easily applied greases can be used for high temperature service because of the combined mechanical and thermal stability imparted by Estersil GT. These softer greases, of course, are more readily handled at low temperature than the more conventional types.

6. Ease of Manufacture—The completely synthetic preformed thickening structure allows reproducible grease preparation through a simple milling operation.

Du Pont will be glad to send a representative to discuss the formulation of improved greases with Estersil GT. A grease pilot plant is available to assist in this work. Samples of Estersil GT may be obtained by addressing your inquiry to Wilmington, Delaware.

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

Regional Offices:
NEW YORK, N. Y.—1270 Ave. of the Americas . . . Phone COlumbus 5-3620
CHICAGO, ILL.—8 So. Michigan Blvd. . . . . Phone RAndolph 6-8630
TULSA, OKLA.—1811 So. Baltimore Avenue . . . . . Phone Tulsa 5-5578
HOUSTON, TEXAS—705 Bank of Commerce Bldg. . . . . Phone PReston 2857
LOS ANGELES, CALIF.—612 So. Flower St. . . . . Phone MAdison 5-1691

IN CANADA: Du Pont Company of Canada Limited—Toronto, Ont.—Montreal, Que.—Calgary, Alta.
OTHER COUNTRIES: Petroleum Chemicals Export—Nemours Building 6539—Wilmington 98, Del.

The LOOK BOX for August . . .

Competition And Service

KEEPING shelves supplied with items for the consumer is standard business practice. Competition makes it so, for we all know that if one shop doesn't have what we want, we can go to the next.

Know what is involved when the oil industry keeps its shelves supplied? Well, Frank Porter, API president, recently pointed out that "the value of crude oil and four major products alone tied up continuously in pipe lines, ship bottoms, tank cars, etc., is in excess of $1 billion."

This is only part of the story that every oil company should make plans NOW to emphasize during Oil Progress Week, October 10-16. How oil competition serves the consumer is the theme. Notice the words *competition* and *service* and in your Oil Progress Week planning bear down on them.

The Oil Industry Information Committee, American Petroleum Institute, 50 West 50th Street, New York 20, has a great deal of material that will assist any company that wants to join hands with the Oil Progress Week effort. With every oil company interested and active, this special week can't help but make an imprint that will rebound to the benefit of the industry as a whole. whole.

100 Million Motors

THE WORLD total for vehicles of all classes which are used on the roads or on the land now totals almost 100 million according to the May, 1954 issue of *The American Automobile*. The breakdown on the total shows that automobiles and commercial vehicles account for 81.6 million with the balance being made up of tractors, motor cycles and other types of vehicles using internal combustion engines. These figures indicate an over-all increase of 7.6 percent in motor registrations over the previous 12 month period.

These figures are of interest to the oil industry primarily because they are an indication of the size of the market for some of the major products of the industry. As sometimes happens in many other industries, there may be a temporary oversupply of certain products, but the basic market is tremendous and is increasing.

Crude Runs Are Reduced

MILD REDUCTIONS in crude runs have been announced by many refiners throughout the country. Although many of these decreases appear only token in nature, the net effect will be to reduce production, and hence inventories, of gasoline. Announced purpose of the cutbacks is to combat softening gasoline prices.

The optimum inventory level is not readily apparent, although most observers will agree that present levels are too high. Increased availability of tankage and higher crude throughput capacity undoubtedly warrant higher inventory levels than those carried during comparable periods in 1952 and 1953.

For sometime gasoline price wars have existed in various eastern areas. In early July wholesale gasoline prices sagged in the Gulf Coast area. That was followed by tank wagon price reductions of 0.5 to 0.7 cents per gallon throughout most of the eastern marketing territory. Greater drops occurred in a few other spots. At about the same time, gasoline price wars broke out in Denver and Los Angeles.

In back of these gasoline price reductions are bulky inventories. Gasoline stocks in mid-July were 20 million barrels larger than they had been a year before and 45 million above two years ago. Thus, gasoline stocks are about 38 percent greater than two years before, while gasoline demand has increased only about 7 percent during the period.

If motor fuel stocks could be drawn down about 20 million barrels by October 1, the industry could possibly avoid an excessive build-up next winter. Causes for the gasoline surplus have been attributed to excessive production, and failure of consumption this year to measure up to expectations. Demand for motor fuel during this year's first six months gained only 1.3 percent over last year's comparable period, while an almost 5 percent hike had been anticipated.

Dry holes don't deter the oil man. He continually seeks new frontiers, and competition is as strong in that field, as it is in the market places. Beyond that, the prime requisite to success in finding oil is freedom—freedom to explore, freedom to develop and produce the oil once it is found, and freedom to sell the products of crude oil in a free market.

—FRANK M. PORTER, President,
American Petroleum Institute

NO SHUTDOWNS . . . *EVER* . . . to repack these mixers

Any fluid mixer on a big tank sooner or later requires some maintenance. A stuffing box needs repacking. A mechanical seal has to be replaced.

You can't always wait for the tank to be empty. You don't want to waste time draining the tank.

And you don't have to do either.

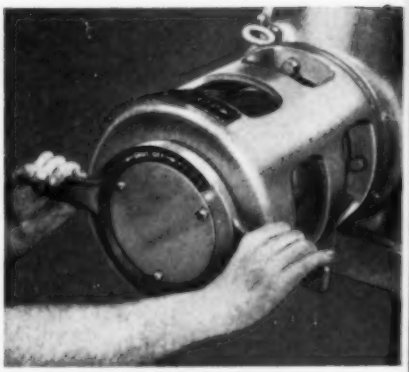
You can repack the stuffing box (or replace the mechanical shaft seal) on a LIGHTNIN Side Entering Mixer, without ever draining the tank. You can do it in a few minutes—under a full head of 5 million gallons—without losing a pint of product.

EASY AS CLOSING A VALVE A few turns of the easy-to-get-at shutoff assembly prepare the mixer for repacking (or seal change). Every part is easily accessible.

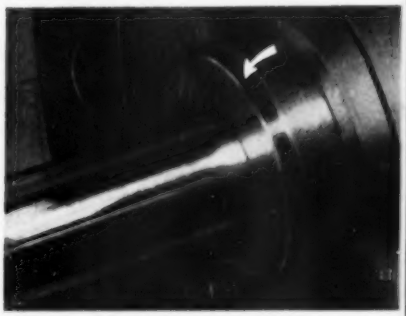
You're always protected against mechanical seal failure. The LIGHTNIN shaft seal (optional now on side entering mixers) is a complete "package" unit—quickly replaceable at any time, without removing the mixer from the tank.

This is just *one* good reason why it pays to specify LIGHTNINs for blending, treating, TEL addition, bottom sediment control in crude storage tanks, and other big mixing operations.

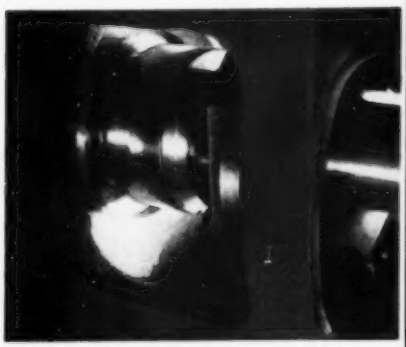
For quick, competent help—and fully guaranteed results—on *any* fluid mixing job, big or small—call in your LIGHTNIN representative. Or write us today.



1. FASTER MAINTENANCE. To repack (or change a mechanical seal), this shutoff assembly is turned like a valve, quickly sealing tank contents from mixer.



2. SHAFT RETRACTS, squeezing a Teflon gasket inside the tank between seal collar and mixer end cap, positively preventing loss of product.



3. MECHANICAL SEAL (optional) can be removed from shaft as a unit, for quick easy replacement. You can change seals without draining the tank and without dismantling the mixer.

- ☐ DH-50 and DH-51 Laboratory Mixers
- ☐ B-102 Top Entering Mixers (turbine and paddle types)
- ☐ B-103 Top Entering Mixers (propeller type)
- ☐ B-104 Side Entering Mixers
- ☐ B-106 Condensed Catalog (complete line)
- ☐ B-107 Mixing Data Sheet
- ☐ B-108 Portable Mixers (electric and air driven)
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MIXCO fluid mixing specialists

How to Get Ahead—

WHILE THERE ARE, we are told, people employed in the petroleum refining and petrochemical business who do not give a hang about improving their position, we think that the number of such people is small. "Advancement, promotion, brings increased responsibilities," is the reason given for the aversion to promotion.

There isn't much we can say to this kind of man excepting to suggest that "if you have a philosophy of non-advancement, it is your right, but don't read any more of this! Turn to some part of this issue which will help you hold your job as younger folks go by you on their way up."

This trend of thought all started when somebody said something about a friend of ours who had had a steady but non-spectacular advance in his company during the past few years.

"That man is going to head his company and be a credit to it," we remarked, "I wonder if there is a formula for it!" So we asked, "Would you mind giving us a formula for success in this business?"

"I won't write it," he replied, "I'll tell you, but don't use my name because all I can say to you is what I have *tried* to do. I didn't always do it, but I think I got credit for trying. Most bosses are good fellows, else they wouldn't be bosses. Don't call me an expert—don't call me a philosopher—don't call me a wise man. Just say that a fellow who has been through the mill said this."

So with his thoughts and with our language and interpretation, here it is, not necessarily in the order of importance, but just as he gave it:

1. *Always give an honest day's work.* The boss may not always see you do it, but if he sees you not doing it, that's bad!
2. *Strive to make the company money.* Never miss a chance to put an honest buck in the profit barrel. It's simple. The company pays you a salary and the company's representatives expect to get a return on the investment.
3. *You must be completely honest.* That doesn't require an explanation.
4. *If your opinion is called for, give it conscientiously,* completely and back it up until a decision has been made. Then go ahead and in good humor, carry out the orders.
5. *Learn the difference between apple-polishing and being courteous.* There is one whale of a difference. Apple-polishers and "yes" men are almost universally looked down upon, but courtesy will earn you courtesy in return and respect as well.
6. *Don't gripe about the peculiarities of your boss or the policy of your company.* If it is such that you can't live with it, change companies. Life is too short to spend griping or apologizing for what your company does, and if its policy is bad it won't last!
7. *Avoid alibis.* If you had a good reason for doing a certain thing which turned out wrong, state what it is and let it stand at that. In most instances, your boss has been along the same ground on his way up and he knows an alibi when he sees it.
8. *You'll learn more listening than talking.*
9. *If you enjoy your work, act like you enjoy it.* If you find you consistently don't enjoy it, change jobs. Often square pegs do find a way into round holes and it is a tragedy when this continues, especially among intelligent and well-trained men who have a genuine future in this business.
10. *There is no substitute for enthusiasm.* This doesn't mean going off half-cocked, of course, or innanely bubbling over. A very successful man said to me not long ago, "If I had to choose between a group of highly intelligent and well-trained men, who were lacking in enthusiasm, and a group of enthusiastic intelligent men whose training was not complete, I would choose the second group because I could go further with it."
11. *Do whatever job is assigned to you with the very best of your ability.* Do it as though it were the only job in the world and your entire success in life depended upon doing the job well. Don't be a clock-watcher or a time-stealer.
12. *Be generous in giving credit to others.* It makes everybody happy, makes friends for you and like the Biblical bread on water, can return to you.
13. *Draw as heavily as you are permitted on the experience of others.* That is how most people advance, taking advantage of what they can learn from other people. The wonderful thing about this is that people are always willing to help when they are appealed to as experts.
14. *Do not shirk responsibility.* Accept all the responsibility you can handle. "Here is a secret" said my friend, "the ability to accept responsibility ordinarily grows with the opportunity to yield it. This means that you must be willing to make decisions."
15. *Don't go to your boss to ask him about the handling of details with which you are familiar.*
16. *Stay out of office politics.* It is too hard to pick the winner! Besides it consumes time that you can very well use in improving your own position and the company's position as well.
17. *Don't go barging in, during a conversation with more experienced men,* pushing your opinions on them. Your opinions may be better than theirs but there are better ways of getting your opinion into consideration other than bald assertiveness. Courteous questioning as to why this or that can't be done is worth many times an assertive, "Now in my opinion—."
18. *Be neat in your appearance, clean in your habits and habiliments.* A slovenly looking man easily is credited with mental slovenness.
19. *Be loyal to your company.* All of the foregoing traits without genuine loyalty to the organization with which you are working will avail nothing in advancement if you are suspected of disloyalty.

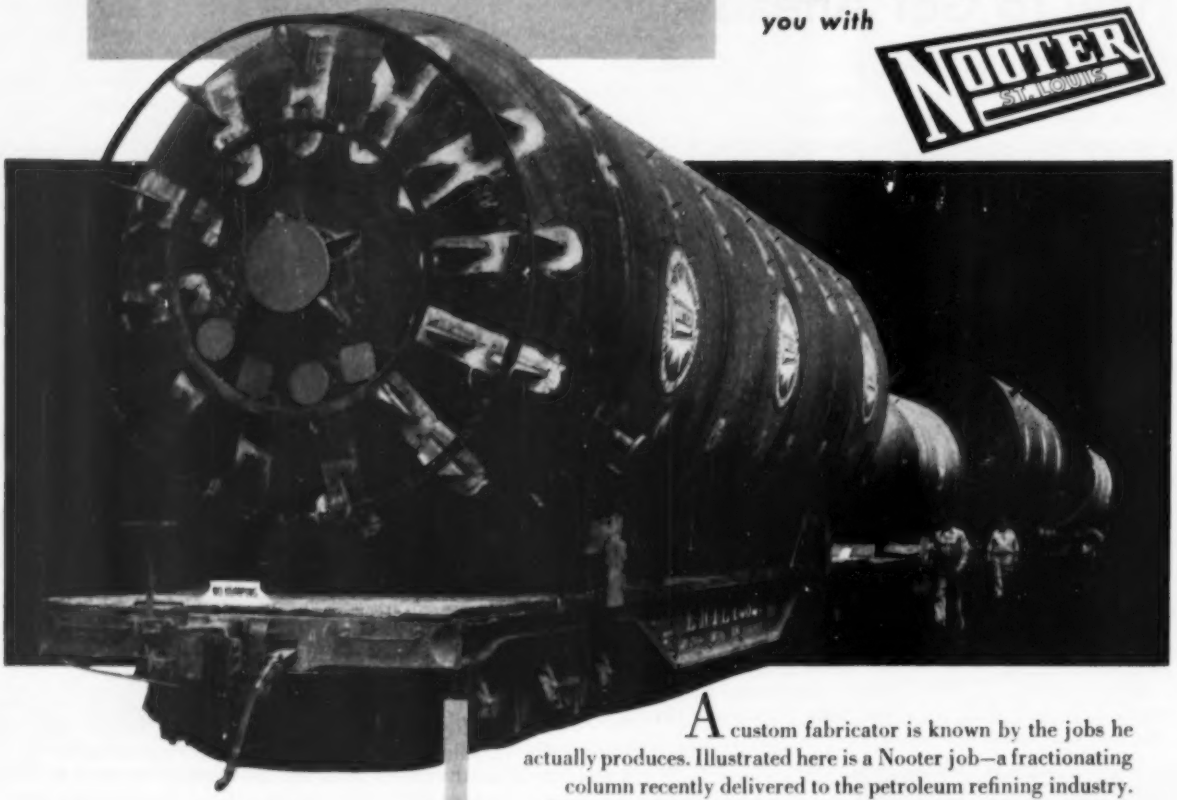
"That's just about the list," said my friend. "I haven't said anything about drinking, taking dope, chasing the other fellow's wife, etc. If you drink, the Alcoholics Anonymous will afford you a refuge and possibly a cure. If you deal in dope, Uncle Sam has his own peculiar way of handling that, and irate husbands have a way of dealing with wife-chasers!

"What I've said isn't copyrighted. It isn't preaching, either. Put yourself in the boss' place and isn't it what you'd like in an employee?"

KNOW YOUR FABRICATOR BEFORE YOU BUY

One of a series . . . designed to acquaint you with

NOOTER ST. LOUIS



A custom fabricator is known by the jobs he actually produces. Illustrated here is a Nooter job—a fractionating column recently delivered to the petroleum refining industry. The size of this job is one example of Nooter's experience:

- 13 ft. diameter, 155 ft. long, weighing 235 tons.
- All-carbon steel, stress relieved in the Nooter Heat Treating Furnace.
- Six flatcars needed to ship to destination.
- Over 10,000 bubble caps, installed in 55 trays. Assembled trays had to satisfy a tray level tolerance of ±1/8".
- Final field assembly, engineered by Nooter Field Construction Dept.
- Completed and delivered on time within 4 months of order.

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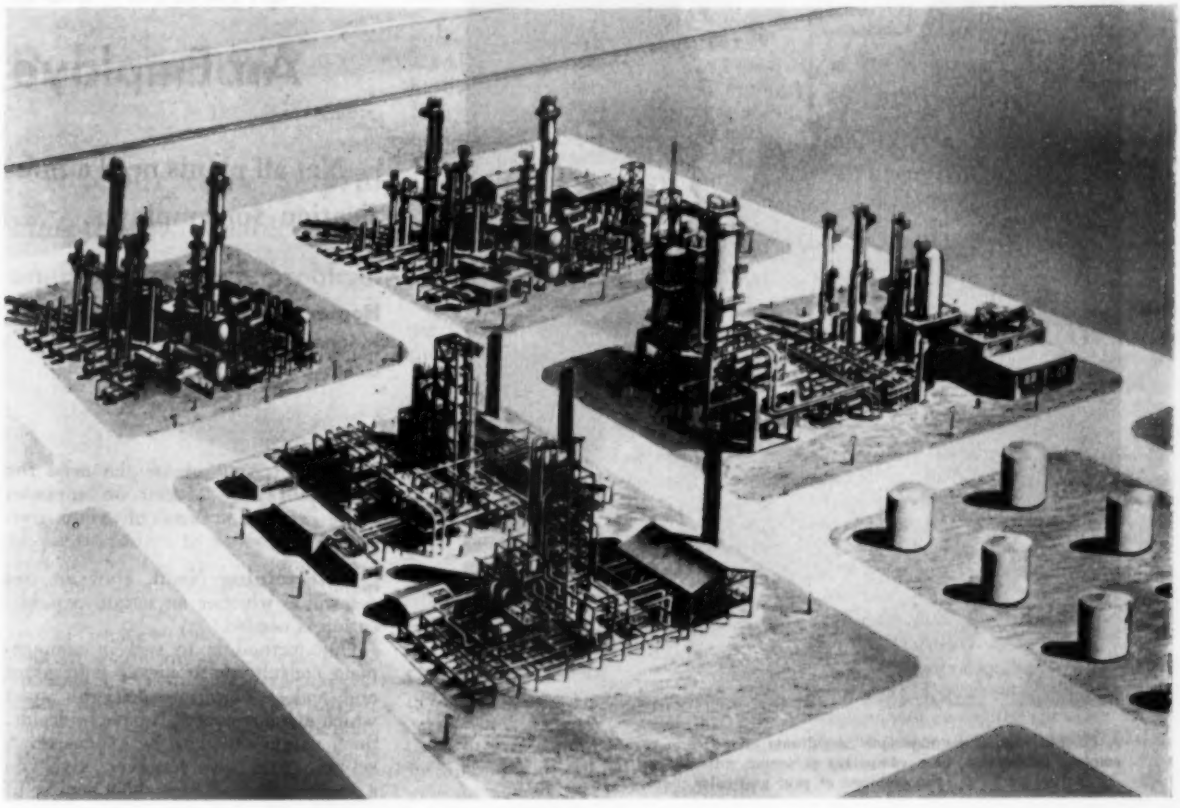

Artist's conception of Commonwealth's refinery being built at Guayanilla Bay.

Work Started on Puerto Rico's Biggest

Commonwealth Oil Refining has started construction of Puerto Rico's newest refinery. With a capacity of 25,000 barrels a day, it will also be its largest.

At Guayanilla Bay, Puerto Rico, 15 miles west of Ponce, construction has started on a modern and complete refinery for Commonwealth Oil Refining Company, Inc.

It will be the largest such installation on Puerto Rico and represents the biggest industrial project to be attracted to the island under its industrial development program.

The Lummus Company, of New York is serving as engineers, designers and constructors for the Puerto Rican venture and has scheduled completion of the project for the last half of 1955.

Production. The new refinery will process about 25,000 barrels a day of Venezuelan crudes. The plant will produce the following finished products: aviation gasoline, motor gasoline, bottled gas, kerosine, diesel oil, and fuel oil.

Facilities. Processing units making up the refinery are: two-stage distillation; Houdry catalytic reformer; Houdry catalytic cracker; vapor recovery; alkylation unit; polymerization unit, and necessary auxiliary units. It will have sufficient storage capacity for crude oil and refined products, and ample shipping facilities and docks capable of accommodating super tankers.

The Company. Commonwealth Oil was organized in 1953 under the laws of Puerto Rico. It has reportedly raised $24,500,000 for the construction and initial operation requirements of the refinery. A. F. Carter is chairman of the board. He is a former president of Shell Eastern Petroleum Products, Inc. During World War II he served as the executive officer of the Army-Navy petroleum board with the rank of rear admiral.

Principals. Carter has announced the election of Charles W. Saacke as president of the company. For the past eight

See PUERTO RICO'S BIGGEST and
More Construction Items
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Should You An Employe

Not all plants need a publication for employes.

Homer T. Fort,
Magnolia Petroleum Company,
Dallas

A reliable firm of management consultants can determine whether you need an employe publication; or a competent personnel staff can do the job by analyzing the problems of your particular plant.

IF YOUR PLANT does not now have an employe publication, the idea of starting one has, at least, probably entered into over-coffee discussions or perhaps been talked with management.

Interest in the employe publication has grown enormously since World War II. Hundreds of new ones have been started, and more than 48 percent of those published before the war have been increased in size. Fifteen million copies of the nation's employe publications reach Americans each month, making them one of the largest of the mass media of communication.

Many of these publications are well-planned and well-edited, tailored to specific objectives and fitted closely into the personnel program of the plant or company. Surveys have shown time and again that, where such publications exist, they are relied upon by employes as the chief source of information on company plans, policies and programs.

But there are a great many more not so successful. Generally, they were started out of the vague feeling that "we ought to have an employe paper" or were created when Competitor X began one for his people. They drift along on their own momentum, seldom justifying their expense, viewed doubtfully by management, issued in a vacuum of disinterest.

Such publications go their uninspiring way chiefly for two reasons: (1) they aren't filling a need; or (2) they were started in the wrong way.

If you are interested in beginning an employe publication, you must concern yourself with these two matters long before the first issue goes to employes. Otherwise, you are putting it behind an eight-ball from which it may never emerge or, if so, only after surgery.

Before discussing these two key points, it should be said that you can get varying advice from a good many people. None of it substitutes for your own analysis of your plant's needs, its policies, its organization. This article offers a guide and certain suggestions, all based on personal experience, on talks with personnel men and editors, and on various studies. It will not, however, eliminate the need for good judgment based on common sense and the facts of your own situation.

Determining Need. How do you determine whether an employe publication is needed?

One method is to call in management consultants to survey your plant and make recommendations upon which management will have to decide. Such surveys tend to be expensive. A reliable firm will, however, give you a more unbiased view, the benefit of considerable experience, and may help overcome any previously formed prejudice.

However, too many successful publications have started without such help to say that it's necessary. A competent personnel staff can do its own analyzing and come out with valid answers provided it does its work in the right sequence.

If you decide to do the study yourself, the bases for determining the need are:

- Nature of employer-employee relations;
- Existence of excessive production difficulties due to lack of information;
- Status of community relations;
- Supervisors' and employes' opinions;
- Size of your working force;
- Character of your working force;
- Purpose and scope of other company publications;
- Suitability of less expensive communications media.

The nature of employer-employe relations is the most important factor in your study. Is your

Start Publication?

Here are some helpful hints that will enable you to analyze your own problem.

work force equal or superior in morale to competitive plants? Does your plant have few grievances or "gripes" based purely on failure to understand a contract or company plan or policy? Are there only rare complaints about management secrecy? Do you lack any special problem on which a partial solution would pay out the cost of the publication? Your employes may not agree with it—but do they appear reasonably well informed on company policy? If your plant is unionized, is there enough pride in company to say that the "dual allegiance" to company and union exists? In general, does your plant have a reputation as a friendly place in which to work?

These are some of the more important questions you need to ask yourself and others. Answers of "yes" based on a variety of opinions might well indicate that you don't need a publication, that your present information program is good enough.

Remember that the employe publication is only one way of presenting information to employes and that it can't, for instance, substitute for good person-to-person exchange between supervisors and employes. If you are getting information through by other methods, you can save yourself money by forgetting a publication.

On the other hand, if you are presently doing little or nothing in the way of an information program, you had best review many "yes" answers to the above questions. Employe attitude is governed to a tremendous extent by whether or not employes believe they are "in the know," whether they feel themselves to be important and respected members of a group doing important work. That feeling simply doesn't exist where information is solely a management commodity.

Excessive production difficulties due to lack of information can be a prime reason for considering a publication. There exists with any job a body of fact that the employe must have if he is to do efficient work. Many of these facts are handed to him in the course of day-to-day contact with his supervisor. Others sometimes are not. These questions are pertinent:

Do supervisors and employes know the "why" of changes in equipment and installations so they can exercise individual good judgment if required?

Do changes in operating procedure get to employes within a reasonable time?

Are there many breakdowns due to suspicion or misunderstanding of other departments and their function?

Any large organization doing a complex job endures communications breakdowns that disrupt production by causing waste or inefficiency. Existence of a large number of these or too many of importance would indicate some need for a publication.

Your community relations program also should be considered. An employe publication, sent to key individuals in the community, can help carry your story. If community relations are mediocre due to lack of an information program, a publication may do some good. It will accomplish little, however, if the cause lies in basic management policy.

Supervisors' and employes' opinions should be consulted in determining the need. Don't get them by asking directly if they think a publication is called for. Instead, ask them—on a "drop in and shoot the breeze" basis—what they think about conditions that would be dealt with by a publication. Keep the conversation away from generalities. Make some inquiries as to any specific problems they have in which they think a publication would help.

The purpose of such an interview is to determine the true need. There is a tendency to answer, "Sure, we need one" on the basis of having seen other plants' publications or in the general attitude of "it won't hurt and it might help." That tendency can be overcome only by careful exploration of the individual's reasoning.

The size of your work force has considerable importance in your analysis. Opinions as to the exact figure differ, but it's generally agreed that a publication isn't the best way to tackle employe information when the force is less than 300. The figure might be raised to 500, but with more argument. Above that number—and with other facts indicating need—it might be called for. A small plant might give some thought to making better use of its bulletin boards. The revival of the bulletin board as an effective and attractive medium of communication has come in recent years. There are helpful descriptions of how to use it available from the U. S. Chamber of Commerce; *The Score*, newsletter published by Newcomb and Sammons; and other sources.

An alternative to the bulletin board —or a supplement—is use of periodic management newsletters mailed to employes. These, too, can be highly effective.

The character of your work force is another factor. In refineries, dispersal of equipment, shift work and frequent personnel moves among shops and departments tend to reduce effectiveness of bulletin boards and to lessen intimate supervisory contacts no matter how much effort goes into maintaining them. They are, for that reason, more adapted to publications' use than are industries where employes are concentrated in a few large buildings.

The proportion of younger men in the total bears on the question, since, in general, younger men have more need for orientation and selling on company philosophy. Other factors include literacy and command of English. If as much as 25 percent of employes would not be able to read a publication with reasonable ease, then some other form of communication should be used.

Purpose and scope of other company publications has a very important bearing on the determina-

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Next Month—

How to Start an Employe Periodical

If, after reading this article, you decide that you do need a company publication, you will receive great benefit from Mr. Fort's article next month on how to go about it.

Someone's Listening!

How to Be Interviewed

Executives are receiving more and more requests for interviews. These six suggestions will help you.

Auren Uris,
Author of "How to Be a Successful Leader"
Research Institute of America, New York

MORE AND MORE executives are being tagged for interviews. Newspaper reporters, writers in the management field, opinion seekers of every shade and caliber, are knocking at office doors across the continent.

How well are executives coming off in these face-to-face meetings?

Without violating any confidences, it can be said right here and now, that for some of the interviewed, as well as the interviewers, the efforts are a waste of time.

Day vs. Night—Executives, hotshots in their jobs, aggressively able to meet every demand and crisis of their daily routine, performed miserably in some cases. Here are two contrasts:

"Mr. Knite," top executive of a large refining operation, comes face to face with a writer who wants to get his views on qualifications of today's executives. Mr. Knite, who has dealt with the problem intelligently for years, finds himself freezing up.

Of course, it's not the poised pencil. Mr. Knite is simply unfamiliar with the role he's supposed to play in the interview situation. He lacks knowledge of the few essentials he must have to prepare properly for it.

Result? The interviewer leaves, no smarter than when he came. His only gain is a doubt as to Mr. Knite's qualifications for his job.

Mr. Knite's feelings of frustration and annoyance need no detailing here.

Happily, the interviewer's next call is on "Mr. Daye," who proves to be more experienced. The encounter is much more fruitful. The interviewer leaves with a notebook crammed with useful information and the opinion that Mr. Daye is very much on the ball.

Yet, the plain fact is, very little difference exists between Mr. Knite's and Mr. Daye's knowledge of the subject.

It's Not What You Know . . .

. . . but what you can get across to the interviewer that makes the difference. It's largely Mr. Daye's ability to handle himself in the interviewing situation that has made it possible for him to come off so well.

How to Prepare—Here are six recommendations that can help you hold up your end of an interview satisfactorily. Chances are you're familiar with most of them. On the other hand, checking your practices against these suggested steps may help you refine your procedure, make your interviews even more successful.

Remember, too, that you can learn something in the course of the interview—if you know the right questions to ask.

1. Find out what the interview is all about.

Generally, the interview may be set up either by letter or phone. Whether by the written or spoken word, you should learn the answers in advance of these questions:

- What's the subject up for discussion? It may be executive training, your opinion as to how business prospects are shaping up, or your views on interplanetary travel.

Whatever it is, you should get the writer to spell it out for you. And don't hesitate to keep on asking questions until he's cleared up your doubts. If he says he wants to get your views on public relations, query him further. Is it the subject of public relations in general that he's interested in? Or is it actually your company's public relations policies he wants to hear about?

- What's his focus? If your statement is simply going to turn up as an item in a statistical table, part of an industry-wide survey, for example, you can be pretty sure the interview will be pretty much a streamlined affair. But if what you give out is going to be featured, your slant on the subject may have to be considerably broader.

Types of Interviews—Generally, interviewers use two possible approaches:

. . . The "closed" interview. Here he's after specific information on a specific subject. He can tell you, "Mr. Jones, my publication is conducting a study to assess the labor needs in this area within the next year." Here—if you like—you can give him the facts, or your assumptions, on the clear-cut track he's set up. His questions will be simple and to the point:

How many people do you have on your payroll now?

Within the next six months, do you expect to have more than the usual number of severances?

Within the next six months, do you expect to be hiring more than the usual number of personnel? And so on.

. . . The "open" interview. The *objectives* of this type of interview may be just as clearcut. But what remains very much in doubt is the *subject matter* of the interview. Here are some interview subjects of the "open" variety: your views on executive leadership; your views on the best ways to motivate people; your views on the critical areas in management today.

The "open" interview is somewhat like a fishing expedition. All the writer knows is the broad outline of his search. He depends on you to lay down the track, the development of the idea or information. To this end, his questions may run something like this:

"Mr. Smith, what's your opinion of the caliber of executive leadership today?"

"Do you think it's improving or growing worse?"

"Why do you think so?"

"Can you give me any examples?"

And so on.

When the interviewer has finished, he probably has a pretty good idea of your views on a *dozen* subjects. But included among those—if he knows his job—is the one he's after.

2. How much time will he need?

It's a simple point, but failure to clear up the time question can lead to mutual disappointment or aggravation.

One well-known magazine reporter recently traveled from Chicago to the West Coast to get the opinion of an industrialist on a series of current topics. The writer had expected to have a full day of the executive's time. The industrialist, not knowing the traveling entailed, had assumed an hour would be adequate!

It's easy enough to ask the interviewer how long he expects the interview to take. The experienced man can usually tell within minutes how long he'll need. This information prevents you from trying to cover a two-hour subject in 15 minutes and keep him from trying to stretch what is to your view a 15-minute break into a two-hour discussion.

See INTERVIEW
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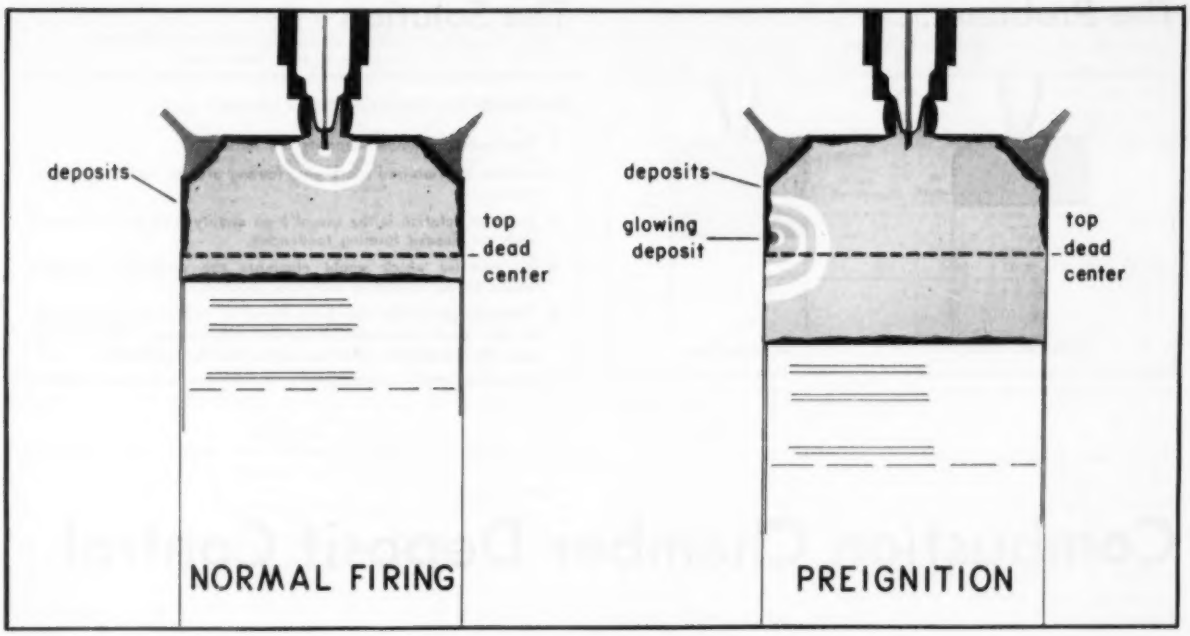


Foreword to

Gasoline Additive Symposium

THE subject of gasoline additives is one of the hottest to come up in the oil industry in many years. Because the use of additives has been tied directly to advertising effort, the general public as well as those in the industry have been aware of the developments in this field. Regardless of the merits of the various claims, almost everyone has had his attention focused on this subject.

Even a casual observer must have also noticed the lack of agreement among the oil companies on several points in regard to the additive question. Basically, disagreement seems to center around these questions:

- Are preignition difficulties encountered by a significant percentage of the motorists?
- Should an additive be used or should the problem be solved by the use of higher quality fuels and lubricants that have low deposit forming tendencies?
- If an additive is the solution, then which additive does the best job?

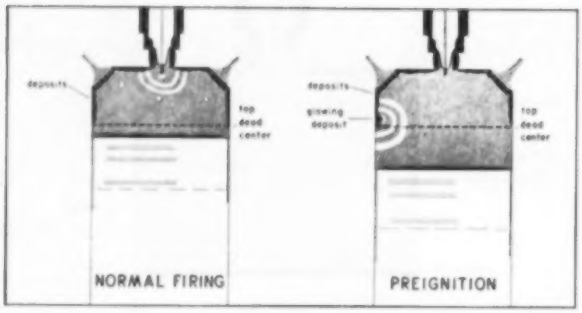
There does seem to be agreement on the definition of preignition. It has been defined as the firing of the combustible mixture of gasoline and air in advance of the firing by the spark plug. This premature firing occurs when deposits build up in the combustion chamber. Certain types of deposits have the quality of retaining heat from the previous firing cycle and in sufficient quantity to glow. If this glowing period lasts until the next cycle, it can cause preignition or surface ignition to occur. The additive solves the problem by changing the characteristics of the deposits so that they no longer have glowing tendencies.

Although interest in the control of preignition has been obvious to one and all for the past year or so, there has been, of course, considerable research and development done along this line for a much longer time. The problem has become more critical with engine design changes increasing the compression ratio. These changes have resulted in more compact combustion chambers and in a requirement for a higher octane gasoline. These factors coupled with certain driving conditions can result in preignition conditions. It should be pointed out, however, that all preignition problems are not confined to high compression engines. Preignition appears to follow very few general rules of behavior. These deviations make it doubly hard for the average motorist to evaluate in his own engine the need for preignition control and the results obtained from using various gasolines.

The purpose of this symposium, then, is to bring together several papers which represent the line of thinking of various companies on this matter. There is no one answer obviously. These papers do serve to emphasize one fact—that the motorist will benefit, regardless of the final answer, from the results of such concentrated effort.

Robert J. Phillips,
EDITORIAL DIRECTOR

The Problem . . .



The Solution . . .

STANDARD OIL DEVELOPMENT COMPANY SAYS:

1. **Combustion chamber deposits are harmful.**
2. **Surface ignition and spark plug fouling are not serious problems today.**
3. **Soundest solution is the use of high quality fuels and lubricants with low deposit forming tendencies.**
4. **An additive which would eliminate the preignition problem would be an attractive alternate solution.**
5. **Tricresyl phosphate has been found to reduce preignition but at the same time increase octane requirements. This additive also has an adverse effect on power and fuel economy.**

Combustion Chamber Deposit Control

C. L. Fleming, Jr., N. V. Hakala and L. E. Moody,
Standard Oil Development Company,
Linden, N. J.

BOTH THE AUTOMOTIVE and the petroleum industries are devoting a great deal of time and effort to devising means of controlling combustion chamber deposits. These deposits cause the high octane requirements of the newer high compression ratio engines after a few thousand miles of service. Based on extensive surveys by the Standard Oil Development Company, the increase in detonation requirement caused by the combustion chamber deposits is by far the most pressing problem resulting from these deposits. They also cause power loss. In some cases, these deposits may cause surface ignition (preignition and post-ignition) and spark plug fouling. (Surface ignition is detected by irreproducible noises (wild ping) during acceleration or by after-running where the engine will run with the ignition shut off). Surface ignition and spark plug fouling are not considered acute field problems at the present time. These conclusions, reported previously,[1, 2] are supported by additional data obtained since the earlier publications.

Elimination of the deposits or their harmful effects would be beneficial to all concerned. Since the octane requirements of the car population would be lower, a given antiknock quality gasoline would satisfy the octane requirements of a greater percentage of the car population.

The soundest approach at present to reducing the formation of combustion chamber deposits and their accompanying harmful effects is the use of high quality fuels and lubricants with low deposit forming properties. A number of publications in the past several years have stressed the role of the fuel and the lubricant in the formation of these deposits. The use of improved motor oils has been demonstrated by a number of investigators as a very effective means of reducing deposits.[3, 4, 5] Improved fuels are being actively studied as an additional method of controlling deposits.

An ideal solution to the problem would be a gasoline additive which would either eliminate the deposits or ameliorate their harmful effects. Unfortunately, extensive studies[1, 2, 6] of a number of possible materials have shown that in every case the material was ineffective, or had serious disadvantages which outweighed its advantages. For example, phosphorus additives have been reported to reduce surface ignition.[7, 8] Extensive studies[1, 2] with one phosphorus additive, tricresyl phosphate, indicated that it did reduce mild forms of surface ignition (wild ping). However, it increased the detonation requirement. More recent data confirm this. In addition, the cars run on tricresyl phosphate showed less power, poorer acceleration times, and had poorer fuel economy.

Field Problems Caused By Combustion Chamber Deposits

All investigators agree that combustion chamber deposits increase detonation requirements and cause power losses. Therefore, these aspects will not be discussed. There is less agreement as to the extent that surface ignition and spark plug fouling are field problems and these will be discussed briefly.

Occurrence of Surface Ignition—Extensive surveys reported in January[1] and April[2] of this year indicated that of 512 late model cars, more than 90 percent were detonation limited in their octane requirements. Less than 10 percent had surface ignition requirements higher than their detonation requirements. Only 1 to 2 percent of cars would not be satisfied because of surface ignition by the highest octane gasolines available in the field today. These data show quite conclusively that detonation is the major factor limiting car performance at the present time.

Results, shown in Table 1, of a more recent survey (G) are in good agreement with these findings. This survey included thirty-two 1953-1954 cars in city-suburban service. The average mileage at the time of the survey was approximately 5000 miles. A number of different fuels and lubricants were represented, so that the result is not specific for any one fuel or lubricant. As shown in Table 1, all of these cars had higher detonation than surface ignition requirements. All but one of these cars would be satisfied by the best gasolines available today.

TABLE 1

Occurrence of Detonation and Surface Ignition, 1953-1954 Cars, Survey G

MAKE	Year	Engine Type	Compression Ratio	NUMBER OF CARS	
				Detonation Limited	Surface Ignition Limited
G	1953	V-8	8.25	8	0
H	1953	V-8	7.5	8	0
I	1954	V-8	8.0	8	0
J	1954	I.L.-6	7.5	8	0
				32	0

This survey agrees with the surveys reported previously which showed that detonation and not surface ignition was the factor limiting octane requirements. The earlier surveys are summarized in Table 2 along with Survey G. (For details of survey procedure see previous publications.[1, 2])

TABLE 2

Occurrence of Detonation and Surface Ignition, Late Model Cars

DATA SOURCE	Total Cars	DETONATION LIMITED		SURFACE-IGNITION LIMITED	
		Number of Cars	Percent	Number of Cars	Percent
Esso Laboratories					
Survey A	46	45	98	1	2
Survey B	69	56	81	13	19
Survey C	11	10	91	1	9
Survey D	24	22	92	2	8
Survey E	29	26	90	3	10
Survey G	32	32	100	0	0
1952 CRC Survey	303	284	94	19	6
Published Data [3]	30	24	80	6	20
	544	499	92	45	8

It should be emphasized that the surveys of late model cars discussed here include many cars whose surface ignition requirements are below the octane levels of existing premium fuels. Such cars would be readily satisfied by fuels of the octane quality now available in the service station. Only a small number of the cars now on the road have surface ignition requirements above the octane levels of existing premium fuels. This conclusion is based on a study of the 544 cars. Of these cars, 22 percent had octane requirements above 90, with 19 percent being detonation limited and 3 percent surface ignition limited. Thus, there are six high-requirement detonation-limited cars for every surface-ignition-limited car. The 90-octane primary reference fuel requirement was chosen as it corresponds to a 92-octane number commercial gasoline which is about the average quality of premium gasoline in the United States. Since many premium gasolines are above this quality, the number of surface ignition limited cars which would not be satisfied by the best gasolines available today is much smaller, probably less than 1 to 2 percent of the car population.

From the data that have been presented, it is concluded that detonation, rather than surface ignition, is the limiting factor in determining car octane requirements in the field today. The high preponderance of detonation limited cars leads to two important considerations in studying methods of solving combustion chamber deposit problem:

- In any solution to the problem at the present time, it will be more important to reduce detonation requirements rather than surface ignition requirements to be truly effective.
- A solution to the surface ignition problem which has an adverse effect on detonation requirements would result in an over-all increase in the maximum octane requirements of the existing car population.

Occurrence of Spark Plug Fouling—Results of surveys reported in January[1] and April[2] showed that spark plug fouling is only a minor problem in the field. These surveys included driver owned and operated cars in addition to cars used in controlled field tests. In the latter case, the operation simulated city-suburban type driving.

These data (Table 3) representing over 1 million miles of service indicate that only a few cars have any serious spark plug difficulties. Therefore, this is not considered a pressing field problem.

TABLE 3. Spark Plug Fouling

	Number Cars	Number of Cars Having*** Plugs Replaced	Percent
Controlled Field Test Cars*	98*	4	4
Survey E	29	1	3
Survey F**	37	1	3
	164	6	4

* Ninety-eight test periods employing eighteen different cars starting with clean plug each test. Total of over 500,000 miles of operation.
** Includes 24 cars listed under Survey D.
*** One or more plugs.

The data on occurrence of surface ignition and spark plug fouling discussed above indicate that some of the harmful effects attributed to combustion chamber deposits are not serious field problems at the present time. However, the deposits do cause sufficient harm from the standpoint of increasing detonation requirement to make it highly desirable to eliminate them or to prevent their harmful effects. One way to accomplish this is to use lubricants and fuels which have low deposit forming tendencies. Another possible approach is through the use of gasoline additives.

Effect of Lubricant and Fuel Composition On Combustion Chamber Deposits

The soundest approach to solving the problems associated with combustion chamber deposits is to eliminate or reduce the amount of deposits formed. This can best be done by use of low deposit forming lubricants and fuels.

As mentioned previously, the basic problem caused by deposit formation is that of detonation requirement increase. By and large, this is related directly to the amount of deposits formed. The amount of combustion chamber deposits formed can be reduced by the choice of the lubricant. The new SAE 5W-20 and 10W-30 oils give 30-40 percent less deposits than either a straight mineral SAE 10 grade lubricant or a conventionally refined SAE 30, (MS; DG) service station heavy duty oil. Data illustrating this are presented in Table 4.

TABLE 4

Effect of Lubricant on Deposits, Controlled Field Test,* Commercial Fuel

LUBRICANT	Total Deposits/Engine, Grams	Relative Deposit Weight (SAE 30=100)
Conventionally Refined Paraffinic SAE 30	134	100
SAE—10 Mineral Oil	117	87
SAE 5W—20	78	58

* Overhead valve, V-type engines, 6000 - 7000 miles.

Because of the deposit reduction, the octane requirements are correspondingly lower. Data obtained in em-

TABLE 5

Effect of Lubricant on Octane Requirement, Commercial Fuels

LUBRICANT	EQUILIBRIUM REQUIREMENT	
	Employe Cars	Controlled Field Test Cars
SAE 5W—20	86	87
Conventionally Refined Paraffinic SAE—30	91*	93
Advantage for 5W—20	5	6

* For SAE 10 Grade of Same Oil.

Gasoline Additive Symposium

ployе cars as well as in controlled field test cars confirm the fact that lower requirements are obtained with the 5W-20 type oils (Table 5).

The use of 5W-20 or 10W-30 motor oil will also be beneficial in those few cases where surface ignition occurs. This point is illustrated by data reported recently by Ethyl Corporation.[5] In single cylinder engine evaluations, using an electronic counter to determine the number of surface ignitions, 5W-20 and 10W-30 oils reduced the number observed by 67-87 percent. Field data illustrating this same point were reported previously by the authors.[2]

By careful selection of the base stock and additive components, it is possible to formulate SAE 5W-20 and 10W-30 oils which are completely satisfactory in all respects. A number of these products are now on the market. In general, they are obtaining excellent acceptance by the consumer and the automotive industry.

The high quality of the fuel used in the Esso Laboratories studies may also account, in part, for the low octane requirements obtained in this work. This gasoline was a premium product having high back end volatility. The 90 percent point is 300-320 F. as compared with many commercial fuels having 90 percent points of 340-360 F. It has been reported[10, 11] that reducing the amount of heavy ends in a gasoline substantially reduces the harmful effects of deposits formed from the fuel. This is particularly true of surface ignition tendencies. Thus, the low 90 percent point gasolines used in the Esso Laboratories studies could have a marked advantage over less volatile fuels in deposit forming tendencies.

Effect of Gasoline Additives

Certain phosphorus compounds have been reported in the literature to be effective gasoline additives to reduce surface ignition and spark plug fouling.[7, 13, 14] The most extensive evaluations of tricresyl phosphate published to date were reported in January and April of this year.[1, 2] These studies indicated that tricresyl phosphate was effective in reducing wild ping type surface ignition although it was not effective in preventing after-firing under severe conditions.

Tricresyl phosphate was found to have a number of deleterious side effects. These include:

- Increased combustion chamber deposits.
- Increased detonation requirements.
- Greater power loss.
- Poorer fuel economy.

Effect of Tricresyl Phosphate on Combustion Chamber Deposits—One of the main constituents of combustion chamber deposits is the lead salts. Halogen compounds are added to the fuel to scavenge the lead by forming low melting volatile lead halides. The phosphate is one of the highest melting and least volatile of the lead salts. Therefore, it is not surprising to find that the addition of tricresyl phosphate to fuel increases the amount of combustion chamber deposits. This has been observed in both aviation[14] and automotive[2] service. In the automotive type engines, the use of 0.2 theory (one theory is the amount of phosphorus to convert all of the lead to lead orthophosphate) tricresyl phosphate increased the deposits by 20-30 percent (Table 6).

TABLE 6

Effect of Tricresyl Phosphate on Combustion Chamber Deposit Accumulation

Type of Test:	WEIGHT OF DEPOSITS*, Gm		
	Field		Laboratory
Engine on Test	Make A	Make B	Make A
Number of Tests—Car Year	3–1953	1–1953	1–1951
Additive in Fuel:			
No Additive	69	101	52
0.2 T. Tricresyl Phosphate	85	133	66
Percent Increase	20	30	25

* Total weight per engine.

These higher deposits result in greater octane requirement increases with the tricresyl phosphate.

Effect of Tricresyl Phosphate On Octane Requirement—In general, the observed octane requirement increase is a function of the amount and type of deposit. Increased deposits result in higher octane requirements. Therefore, because tricresyl phosphate increases the amount of deposits, an increase in detonation requirement accompanies the use of this material. For example, thirteen employee cars whose octane requirement history was well known were switched to a commercial fuel containing 0.2 theory tricresyl phosphate. Previously these cars had operated on a non-phosphorus containing fuel, in combination with one of three oils, until equilibrium octane requirements were reached. The cars continued to use the same crankcase lubricant as was used previously. In eleven of the thirteen cars, after 1000 to 4000 miles on the tricresyl phosphate containing fuel, the detonation requirement had increased. The average increase was 1.7 octane numbers. Table 7 illustrates these data.

TABLE 7

Effect of Tricresyl Phosphate on Car Octane Requirements
(Deposits Built Up on Commercial Gasoline Without Tricresyl Phosphate)

LUBRICANT	Number of Cars	Increase in Detonation Requirement After Use of Fuel Containing Tricresyl Phosphate, Average
Synthetic Oil	4	1.9
SAE 5W–20	2	1.0
Conventionally Refined Paraffinic SAE 30	7	1.7
	13	1.7 Average

The increase in detonation requirement is in good agreement with the data reported previously[1, 2] which are summarized in Table 8. The data in Table 8 represent a variety of field and laboratory multi-cylinder engine experiments. The average requirement increase due to the use of tricresyl phosphate is about 1.9 octane numbers.

TABLE 8

Increase in Detonation Requirement Caused by Tricresyl Phosphate
Commercial Fuels With and Without Tricresyl Phosphate—
Various Lubricants

Number of Engines Operated on Each Fuel:	Type of Test	Increase in Detonation Requirement with 0.2 T. Tricresyl Phosphate in Fuel
8	Field	0.8
2	Field	0.5
4	Field	3.0
1	Laboratory	1.0
1	Laboratory	0.8

Effect of Tricresyl Phosphate on Octane Requirements of High Compression Ratio Cars—Many investigators expect surface ignition will become relatively more severe at higher compression ratios. If this turns out to be the case and more cars become surface ignition limited than detonation limited, then an additive which reduces surface ignition with no attendant adverse effects should have maximum effectiveness. With this in mind, the use of tricresyl phosphate was evaluated in high compression ratio cars.

The evaluations were carried out in two cars equipped with engines of different makes having experimental 9.5:1 and 10:1 compression ratio cylinder heads. Details of the operation are given in a previous publication.[2]

After the cars reached equilibrium (approximately 5000 miles), they were then operated for an additional period on the same base fuel to which 0.5 theory of tricresyl phosphate had been added. This concentration of tricresyl phosphate was chosen since it has been reported to be optimum for reducing surface ignition.

In car Make X at 9.5:1 compression ratio, the limiting octane requirement increased 3 octane numbers after only 600 miles on the fuel containing tricresyl phosphate. The equilibrium requirement was 4 octane numbers higher with the fuel with tricresyl phosphate than with the base fuel (Table 9).

TABLE 9

Effect of Tricresyl Phosphate in High Compression Ratio Engines (Make X, 9.5:1 Compression Ratio)

	OCTANE REQUIREMENTS	
	Detonation	Surface Ignition
Equilibrium Requirement*	95.5	95.5
After Additional Operation on 0.5 T. Tricresyl Phosphate		
600 Miles	98.5	92.0
1300 Miles	99.5	92.5
2200 Miles	99.5	92

* After 5000 miles, commercial fuel, SAE 5W-20 motor oil.

As shown in Table 9, this car was not surface ignition limited even on the base fuel. Furthermore, while tricresyl phosphate was very effective in reducing surface ignition tendencies with the primary reference fuels, it did not reduce surface ignition tendencies of leaded commercial fuels which were also rated in the engine after operation on the tricresyl phosphate-containing fuel.

Similar results were obtained in the other car (Car Y) at 10:1 compression ratio. In this case the requirement had increased by one octane number at 600 miles and 3 at 2900 miles (Table 10).

TABLE 10

Effect of Tricresyl Phosphate in High Compression Ratio Engines (Make Y; 10:1 Compression Ratio)

	OCTANE REQUIREMENTS	
	Detonation	Surface Ignition
Equilibrium Requirements*	95.0	95.0
After Additional Operation on 0.5 T. Tricresyl Phosphate		
600 Miles	96.0	96.0
1800 Miles	96.0	95.0
2800 Miles	98.0	96.0

* After 5000 miles on commercial fuel, SAE 5W-20 motor oil.

It will be noted that there was no decrease in the surface ignition tendencies of this car. Furthermore, in both of these cars the surface ignition and detonation requirements were equal at equilibrium on the non-additive base fuel and SAE 5W-20 oil. This suggests that with high quality fuels and lubricants surface ignition may not necessarily be a problem as compression ratios increase.

Based on all the evidence available to the authors, there appears to be no sound demonstration of a clear cut advantage for the use of tricresyl phosphate in low to moderate concentrations in reducing octane requirements. There are considerable data indicating tricresyl phosphate actually increases octane requirements in present day cars. Limited data indicate that tricresyl phosphate will increase requirements of future high compression ratio cars also.

Effect of Tricresyl Phosphate on Power and Fuel Economy—Data reported previously[2] showed that cars operated on fuel containing tricresyl phosphate lost more power and had poorer fuel economy than those on the base fuel. Recently experiments were carried out at high speed (60-65 mph) using two cars operated on a commercial fuel and two on a similar fuel containing 0.2 theory tricresyl phosphate. In these experiments, the cars using the tricresyl phosphate fuel lost more power (0.8 sec. slower acceleration from 20-60 mph) and had poorer fuel economy (0.3 miles per gallon) than those on the fuel without the additive. While these effects are small and are based on limited data, they are in good agreement with the earlier extensive field data which are shown in Table 11.

TABLE 11

Effect of Tricresyl Phosphate on Power Loss and Fuel Economy (Eight Car Averages—Controlled Field Test)

Additive in Fuel:	None	0.2 Theory Tricresyl Phosphate
Percent Power Loss	2.8	5.0
Fuel Economy, Miles/Gallon	17.7	17.1

It is felt that the poorer performance with the tricresyl phosphate-containing fuel is probably due to the increased combustion chamber deposits formed by the tricresyl phosphate.

Conclusions

Following are conclusions which have been drawn from the work discussed:

(1) Combustion chamber deposits are harmful in that they cause an increase in the octane requirements of automotive engines.

(2) Surface ignition and spark plug fouling are not acute problems in the field today.

(3) The soundest solution to the problems associated with combustion chamber deposits is the use of high quality fuels and lubricants with low deposit forming tendencies.

(4) An additive which would eliminate the problems associated with combustion chamber deposits would be an attractive alternate solution.

(5) The use of tricresyl phosphate in gasoline is not attractive on an over-all basis for the following reasons: (a) It reduces surface ignition tendencies but causes marked increases in octane requirements. It is expected the latter will occur in future type, high compression ratio engines, as well as engines now on the road. (b) Tricresyl phosphate in gasoline also has an adverse effect on power and fuel economy.

ACKNOWLEDGMENT

The results discussed here represent the efforts of a number of other workers at the Esso Laboratories in addition to the authors. The authors take this opportunity to express their appreciation and recognition of these contributions.

BIBLIOGRAPHY

[1] Tongberg, C. O., Hakala, N. V., Moody, L. E., and Patberg, J. B., "Gasoline Additives," SAE Preprint, Detroit, January, 1954.

[2] Fleming, C. L., Jr., Hakala, N. V., Moody, L. E., and Tongberg, C. O. "The Control of Combustion Chamber Deposits," NPA Preprint, Cleveland, Ohio, April, 1954.

[3] McNab, J. G., Moody, L. E., and Hakala, N. V., "The Effect of Lubricant Composition on Combustion Chamber Deposits," SAE Preprint, Detroit, January, 1954.

[4] Overcash, R. L., Hart, W., and McClure, D. J., "Crankcase Oil—An Approach to the Combustion Chamber Deposit Problem," SAE Preprint, Detroit, January, 1954.

[5] Hinkamp, J. B., Toulmin, H. A., Jr., and Wintringham, J. S., "The Measurement and Chemical Control of Preignition in Engines," API Preprint, Houston, May, 1954.

[6] Burk, F. C., Test, L. J., and Jackson, H. R., "The Study of Fuel Additives to Reduce Preignition," API Preprint, Houston, May, 1954.

[7] Williams, R. K., and Landis, J. R., "Some Effects of Fuels and Lubricants on Autoignition in Cars on the Road," SAE Preprint, Atlantic City, N. J., June, 1953.

[8] Bowditch, F. W., Wilson, R. E., and Nebel, G. T., "Some Aspects of Particle Ignition," API Preprint, Houston, May, 1954.

[9] Winch, R. F., "The Occurrence of Preignition in Present Day Cars in Normal Service," SAE Preprint, Atlantic City, June, 1953.

[10] Gibson, H. J., Hall, C. A., and Hirschler, D. A., "Combustion Chamber Deposition and Knock," SAE Preprint, Tulsa, November, 1952.

[11] Hirschler, D. A., McCullough, J. D., and Hall, C. A., "Deposit-Induced Ignition," SAE Preprint, Atlantic City, June, 1953.

[12] "Gasoline Additives—Yes or No," Pet. Proc., February, 1954, pages 205-207.

[13] Rendel, T. B., "Fuel Deposits and Spark Plug Fouling," National Petroleum Association, Cleveland, Ohio, April, 1952.

[14] Johnson, C. R., and Harris, D. W., "Service Experience with TCP Fuel Additive," SAE Preprint, Detroit, January, 1953.

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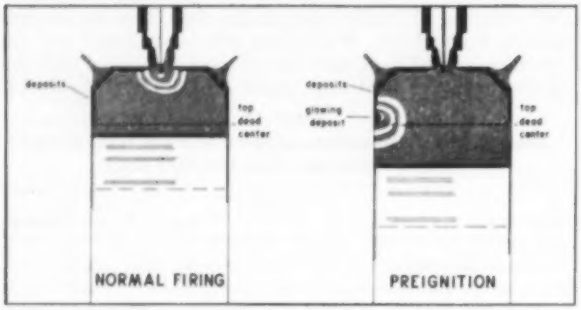
The Problem . . .



The Solution . . .

SHELL OIL COMPANY SAYS:

1. The problems of surface ignition and spark-plug fouling are widespread today.
2. The most effective way to counteract these problems is by the addition of phosphorus-type compounds to the fuel.
3. Tricresyl phosphate is very effective in eliminating these problems.
4. Studies of engines using gasoline containing tricresyl phosphate indicate no adverse effects on engine life.

Improve Fuel With Phosphorous Additives

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New York

FEW PERIODS in the history of the American automobile have produced as many revolutionary changes in engine design as have the past five years. The new engines have shown significant increases in power output and specific gasoline economy. These increases in performance have been made possible by improved breathing capacity, increased compression ratio, improved combustion chamber design, and reduced engine friction. These developments have resulted from years of research by the automotive industry. To the car owner they mean smaller engines for higher horsepowers, well balanced with automatic transmissions and rear axle gear ratios to give him an automobile of high performance, yet one which is economical to operate.

The increased specific power outputs (horsepower per cubic inch of piston displacement) of the new engines have made them more critical with respect to engine deposits. As a result, certain problems have been encountered in service, two of which we should like to discuss. They are the rather general occurrence in spark plug fouling at unexpectedly low mileages and, in some of these engines, a considerably increased tendency toward deposit-induced ignition or surface ignition.*

Spark Plug Fouling—Many people drive their cars under conditions typical of city driving. During that time, deposits are accumulating in the combustion chambers and on the spark plugs. When the car is accelerated, those deposits rapidly decrease in electrical resistance as the temperature increases. Missing of the plug then results, and this may continue intermittently for several successive cycles of the engine. The deposits cool down because that cylinder is not firing and regain some of their electrical resistance. The spark plug may then fire a few more times before deposit temperatures are again raised to the point where intermittent missing occurs. Thus, the spark plug fouling mentioned here is not necessarily complete fouling, but is usually intermittent missing under accelerating and high-load conditions. The missing may come and go in different cylinders of an engine, particularly in the higher powered ones. The result is engine roughness and power loss leading to driver dissatisfaction. Furthermore, since missing occurs when the power demand on the engine is high, any unexpected power losses could lead to serious consequences in heavy traffic on the highway.

It is not uncommon today to hear reports of spark plug replacement at from 2000 to 5000 miles, whereas 10,000 miles was the expected normal replacement period. In car performance surveys conducted on the East Coast using a typical cross-section of cars on the street, 50 cars out of a total of 71 were found to be missing and were benefitted by the installation of new spark plugs. Surprisingly, even the older cars showed many instances of spark plug missing in these surveys, although the engines of recent design showed the greatest prevalence. It is significant

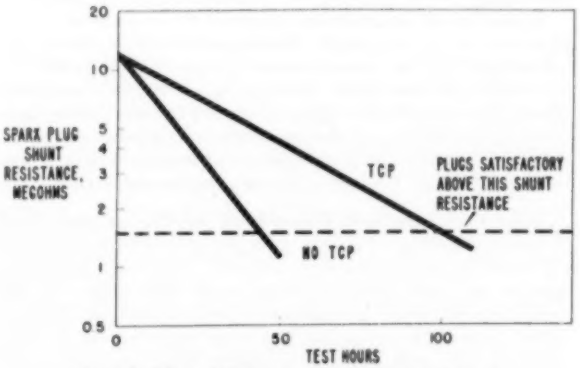

Figure 1. Effect of TCP on spark plug shunt resistance.

* Abnormal combustion processes discussed in this article are defined in accordance with the new CRC Definitions.

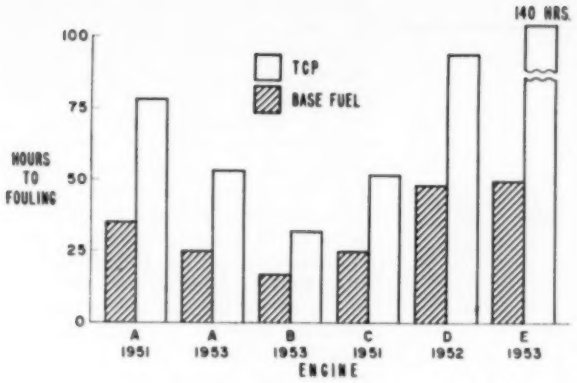

Figure 2. Effect of TCP on spark plug fouling (laboratory engine tests).

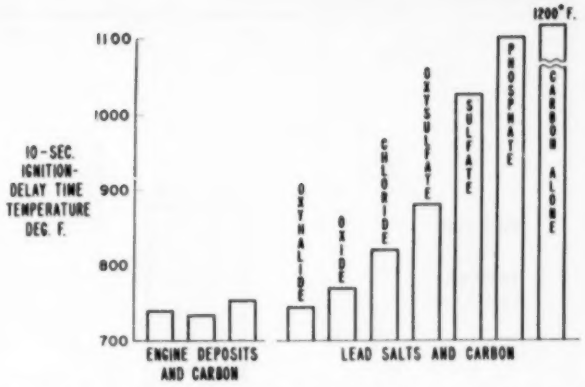

Figure 4. Ignition temperatures of engine deposits and mixtures of lead salts and carbon.

that only in the last few years has the missing problem reached such proportions that it is recognized as a definite field problem by the manufacturers of engines and spark plugs.

Surface Ignition—The second problem, surface ignition, is the initiation of a flame front by any hot surface other than the spark discharge prior to the arrival of the normal flame front. Surface ignition may produce an erratic knock called "wild ping," or a dull thudding knock, both of which are most annoying to the owner. It can also produce a silent type of combustion disturbance called "non-knocking surface ignition." In any event, the result is a rough engine and power loss. Surface ignition is not a new problem. It has occurred in some engines under some driving conditions for many years.

Engine research over the years has developed engine designs which have made the recent high compression ratios possible. However, current compression ratios are seriously pressing the surface ignition limit and can be expected to continue to do so as engine designers exploit the possibilities of still higher compression ratios and higher octane fuels. Thus, it appears that surface ignition is becoming the limiting fuel performance factor. Consequently, no problem is receiving greater attention today on the part of the automotive and petroleum research groups than that of surface ignition.

Combustion Chamber Deposit Modifiers—Early in the experience with tetraethyl lead as an antiknock compound, it became apparent that some means had to be provided to prevent excessive lead deposition in the engine.

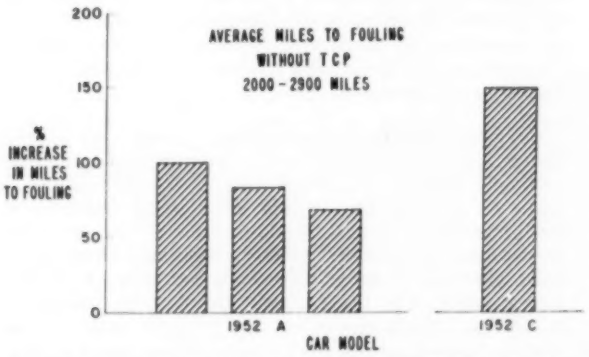

Figure 3. Improvement in spark plug life with TCP (SWRI road tests).

It was then found that certain bromine and chlorine compounds were reasonably effective in reducing such deposits. These active chemicals, however, had to be employed in concentrations which would not cause engine damage. The resulting deposit control has been commercially acceptable until recently. Many research laboratories have been challenged by this problem, and much work has been done to find more effective chemical scavenging agents. As a result of this activity, several compounds have reached the field trial stage, but none of them has been found attractive enough to warrant commercial use.

A second approach to this problem is to modify chemically the deposits remaining in the combustion chamber to reduce their harmful effects. This approach, too, has been given considerable study by many laboratories. Various compounds of boron, silicon, chromium, cobalt, and other materials have been tried without significant success. Until recently, no deposit modifiers had been found which were effective and which produced no adverse side effects. Some of the more important properties required of successful deposit modifiers follows:

1. Must be chemically reactive with existing deposits on spark plug porcelains to reduce their electrical conductivity.
2. Must be chemically reactive with existing combustion chamber deposits to reduce their ignition tendency.
3. Must be soluble in gasoline under all practical conditions.
4. Must have no adverse effects on gasoline stability.
5. Must have proper volatility to reach the combustion chamber.
6. Must not produce adverse deposits in kind and amount.
7. Must not cause damage to engine parts.

After studying a large number of different chemical compounds, the Shell laboratories have found that those containing phosphorous best meet the above requirements. Several phosphorous compounds were found to be somewhat effective with respect to surface ignition, but only a few showed beneficial effects with respect to spark plug fouling. Tricresyl phosphate, in certain proportions with tetraethyl lead and the conventional scavenger, was found to be exceptionally effective in both respects and met all other requirements.

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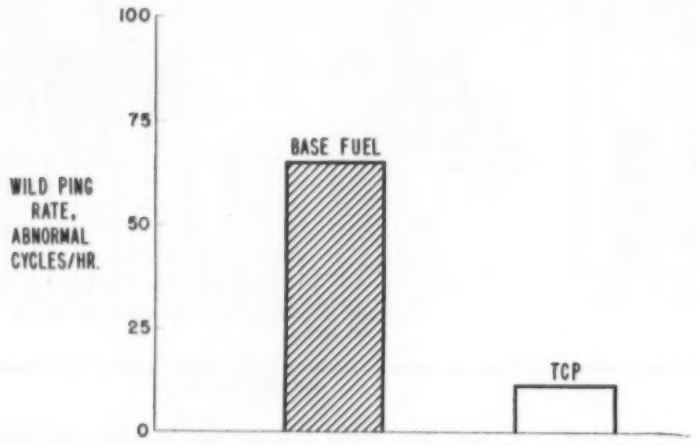


Figure 5. Reduction of wild ping with TCP in presence of pre-formed deposits (laboratory wild ping test.)

Shell has developed a gasoline additive of which a tricresyl phosphate is a major component. The tests discussed in this article all used this particular additive.

Spark Plug Fouling—Laboratory Engine Tests—Since the spark plug fouling problem at early mileages is of relatively recent origin, no widely recognized test methods had been developed to study fuels and additives in this respect. After considerable work in the laboratory and with road correlation studies, an engine test method was developed to simulate the spark plug fouling problem encountered in service. Fouling is determined by power loss and engine roughness during full throttle power checks.

As a further aid in determining spark plug condition, the shunt resistance of plugs (the actual electrical resistance of the path across the spark plug insulator to ground expressed in megohms) is also measured during the above test. Although the actual measure of the condition of a plug is its ability to fire consistently the mixture in the combustion chamber, these spark plug resistance measurements give considerable useful information. Typical spark plug shunt resistances encountered under city driving conditions are shown in Figure 1. It should be noted that Shell's additive considerably delayed the time required for low shunt resistance to be encountered.

Typical data obtained using this laboratory test procedure with several makes of engines are shown in Figure 2. Well over 100 percent improvement in spark plug fouling time was obtained when certain proportions of this additive were added to the base fuel (a premium gasoline containing tetraethyl lead and conventional scavenger). It is apparent that there is considerable difference in severity among engines in regard to spark plug fouling. Another interesting point is the difference between the 1951 and 1953 model of the same make engine. The 1953 engine is more severe, since significantly less time was required for plug fouling. The principal design differences of the 1953 engine were higher power output, better breathing, and a 12-volt ignition.

Spark Plug Fouling—Road Tests—In order to check correlation with results obtained from the above laboratory test, a road test program was devised to simulate the difficulties reported from cars in customer service. Eight cars of two makes were used in this test and were operated under metropolitan driving conditions, including frequent stops with top speed limited to 25 miles per hour. Full throttle accelerations were made at 500-mile intervals and spark plug missing, when it occurred, were readily detected by engine roughness during the acceleration period. Four cars were operated on gasoline without a phosphorous compound added, and the other four operated on the same gasoline with the phosphorous-containing additive. After the first test, the fuels were then switched in the two groups of cars and the tests repeated. These results are illustrated in Figure 3 and show that the improvement in spark plug mileage with the additive in these tests ran from 70 to 150 percent.

Another series of road tests has been conducted in owner-driven cars to explore more fully the performance effects of this additive in actual service. In this work, the cars were selected at random from those which had not previously used a phosphorous compound. At the start of the test, the cars were carefully checked for spark plug missing, preignition, and octane requirement. The cars were then returned to their owners who drove them using gasoline with the Shell additive for periods of 700 to 1500 miles, according to their normal driving habits. After this had been done, the cars were again carefully checked for plug missing, preignition and octane requirement. Out of 14 cars found to be missing, the use of the additive eliminated this malfunctioning in ten cases, reduced it significantly in two, and the remaining two cars were found to be missing on the recheck because of cracked spark plug porcelains. Thus, the addition is shown to have a powerful effect in enabling spark plugs to recover satisfactory performance.

Not only did this road test indicate that the average motorist is apt to encounter considerable spark plug fouling, especially in metropolitan-type driving, but it also gave information on the extent to which spark plug fouling influenced engine performance. Probably the first thing that would be noticed by the customer is that his engine was rough during acceleration. Not only was the engine rough, but a loss in acceleration rate up to 18 percent resulted. Spark plug fouling also reduced gasoline economy. Losses up to 15 percent in economy were not uncommon under moderately high speed conditions.

Based on these owner-driven road tests, the average motorist will quite easily observe that he has a much smoother operating vehicle when using a fuel containing an effective phosphorous-type additive due to the reduction or elimination of spark plug fouling. If he is a careful observer, he will find that he is also obtaining more power and better fuel economy.

Surface Ignition—Laboratory Tests—As noted above, surface ignition has been a problem for some time, and only recently has there been a standardization of terms to describe the various phenomena encountered. Such terms as wild ping, thudding, rumble, etc., are used to describe the various audible vibrations which result from abnormal ignition. However, ignition from any source other than the properly timed spark results in power loss, rough operation, and frequent noise. If this surface ignition results from a hot valve or spark plug or other engine design factors or adjustments, there is little

that the fuel supplier can do to control it. However, abnormal ignition is frequently caused by deposits which are subject to modification by fuel and oil composition. Combustion chamber deposits contain carbon and certain lead salts. These salts behave as catalysts to lower substantially the ignition temperature of the carbon. Under certain conditions, these deposits glow and attain a sufficiently high temperature to ignite the air-fuel mixture independently of the spark. However, in the presence of phosphorous, lead-phosphorous complexes are formed which do not adversely affect the ignition temperature of carbon. The combustion chamber deposits in this case have markedly greater resistance to oxidation or burning. Surface ignition, therefore, will occur much less frequently, if at all.

Data concerning the ignition temperatures of engine deposits and stimulated materials were obtained from a test procedure using a steel block containing a number of wells. The block was heated to a given temperature and lead salts and carbon mixtures were introduced into the wells. Measurement was made of the time required for ignition of the carbon mixture. It is shown in Figure 4 that for an arbitrary 10-second delay time engine deposits ignite at a temperature of around 750 F. The synthetic mixtures of deposits of various lead salts and carbon were found to have ignition temperatures ranging from 750 to about 1000 F. It should be noted that the engine deposits obtained from combustion chambers compare well in ignition-delay characteristics with those of lead oxyhalide and lead oxide. It is important to observe in this figure that the lead phosphate-carbon mixture required a temperature of 10-second ignition delay time nearly as high as that required by pure carbon.

Many engine test methods have been used both in the laboratory and on the road to study this surface ignition problem. In most cases, these tests have consisted of a period of cyclic operation to build up deposits, followed by a period of operation to measure the tendency for abnormal ignition to occur. One method that has been used by a number of laboratories is a "wild ping" test originated by Ethyl Corporation. This is a single-cylinder engine test which uses an ionization gap and an electronic counter to determine the number of abnormal combustion cycles which occur. Shell has applied this test technique to the study and evaluation of potential surface ignition suppressants.

Typical results from this test are shown in Figure 5. The stabilized number of abnormal cycles per hour on a premium gasoline containing 3 cc. tetraethyl lead per gallon was 60. The use of this premium gasoline with the Shell additive reduced the number of abnormal cycles due to deposits to 12 per hour.

Surface Ignition—Road Tests—The incidence of surface ignition was also explored in cars in controlled road tests. In this work, city driving was simulated by a driving cycle consisting of a two-minute idle period followed by a five-minute operating period at 30 miles per hour. After every 120 miles of operation, three level-road, full-throttle accelerations from 20 to 40 miles per hour, and two up-hill accelerations from 20 to 40 miles per hour were carried out. Engine temperature and surface ignition severity increased from mild during the first acceleration to severe during the last up-hill acceleration. The incidence of surface ignition noise was recorded during each acceleration.

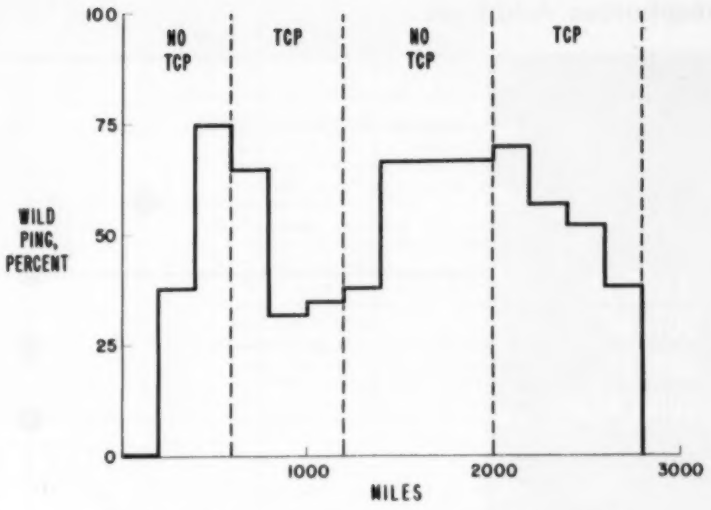


Figure 6. Reduction of wild ping with TCP road wild ping test.

Typical results from these tests are shown in Figure 6. With no phosphorous compound in the gasoline, wild ping noise was encountered in 75 percent of the up-hill accelerations. After changing to a fuel with Shell's additive, wild ping was encountered in only 35 percent of the up-hill accelerations. However, fuels with the additive almost entirely eliminated wild ping during the level-road accelerations.

The effects of the additive on surface ignition and octane number requirement was evaluated in a series of road tests conducted in owner-driven cars. Out of 20 cars, 14 showed preignition. When retested, after using the additive fuel for 700 to 1500 miles, 10 of the 14 cars were free of preignition. The effects on octane requirements in these tests are shown in Figure 7. It will be noted that the average reduction in octane requirement is about two numbers with fuel containing the additive.

General Considerations—Any sound product development program requires consideration of all possible adverse characteristics or effects. Shell has taken great care to investigate these possibilities in all of the extensive laboratory and field work. This particular kind of research played an important part in the development of the additive Shell markets and many months were spent testing under road conditions to ascertain its effects on all parts of the engines. Test cars were run continuously 16 hours a day of hard driving for many thousands of miles each on gasoline containing this additive. Ninety-seven cars and trucks also were operated in regular day-to-day service

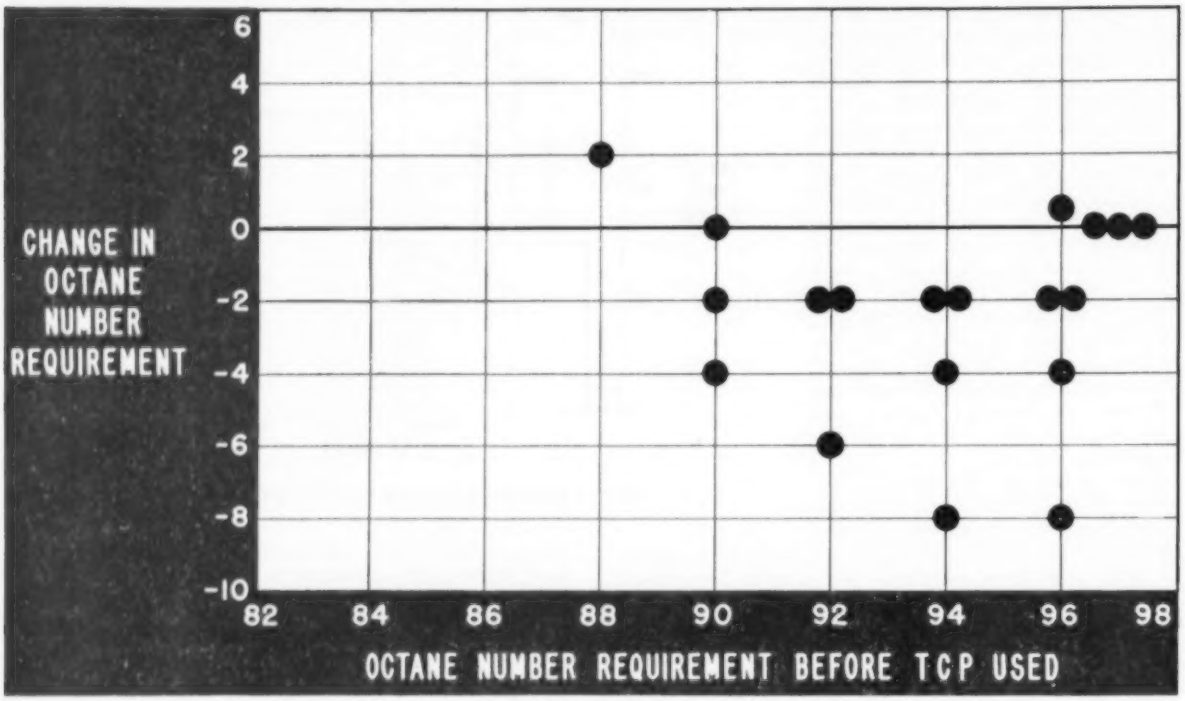


Figure 7. Change in octane number requirement after 700-1500 miles with TCP fuel.

with this gasoline for 18 months for an aggregate total of more than 1 million miles. Careful examination of the engines during and following these tests showed that the Shell additive had no harmful effect on any engine part.

There is no doubt that engine tests can be evolved of such severity that some critical parts can be damaged whether an additive is present or not. These tests measure the durability of engine parts, and it is most difficult to compare gasoline performance in them. Realistic tests, each of which has been correlated with some phase of field service conditions so that the whole has been covered, must be used for evaluating the progress of gasoline development. Even in these tests, the inexperienced use of a particular additive under study will often produce misleading results. For example, valve burning has been reported by some investigators when phosphorous compounds were used and, indeed, was observed from time to time in the early stages of our own work. It was learned that the concentration of additive was important in this respect and that, while some concentrations were undesirable under extreme conditions, others had no effect on valves or other engine parts. In fact, continuing research indicates that some concentrations actually improve the life of valves.

The true criterion of performance in all respects must be practical field experience. Following our highly satisfactory laboratory and field tests during the development of the tricresyl phosphate additive, it was blended in premium gasoline and marketed in a large area for approximately one year under close supervision. It is estimated that 100 million customer miles were accumulated in that time. Experience was very satisfactory and no adverse effects were observed. With this broad background in hand, the additive was introduced in all Shell marketing areas nearly one year ago. Vigorous surveillance has shown that engine performance has been improved and that no engine maintenance problems have been introduced.

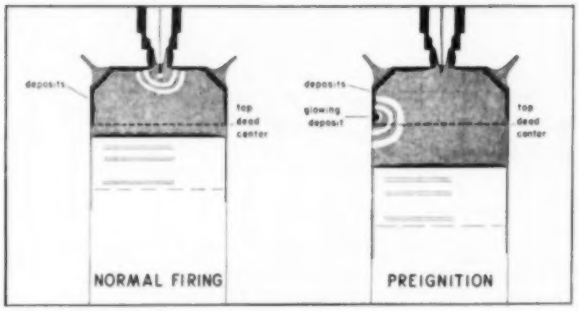
Summary—The important consideration in all this work is—how does this benefit the average motorist on the road? Expectations are that the average motorist will quite easily observe a much smoother operating vehicle when using a fuel containing an effective phosphorous-type additive due to the reduction or elimination of spark plug fouling. A careful observer will find that more power and better fuel economy are obtained.

The effect of phosphorous-type additives on deposit-induced ignition will also be noticeable to the average motorist. The elimination of abnormal combustion cycles, whether they produce noise or not, will result in much smoother engine operation. The elimination of wild ping or erratic knock and the improved smoothness obtained are as important to the motorist as the beneficial effects on power and economy.

It is believed that the deposit modifier approach has been demonstrated to be an effective solution to the pressing field problems of premature spark plug fouling and surface ignition. Among the various types of chemical deposit modifiers which have been studied, several phosphorous compounds meet most of the over-all performance requirements outlined above. The Shell additive appears to meet them all.

Although the additive now used is very effective in alleviating these current problems, Shell is actively engaged in the development of improved materials. Undoubtedly still more efficient additives will be available as they are required to permit the gasolines of the future to meet the requirements of automotive engines in the years to come.

The Problem . . .



The Solution . . .

ATLANTIC REFINING COMPANY SAYS:

1. **The need for, and effectiveness of, various preignition additives is dependent upon the severity of both the engine and the operating conditions used in evaluation. evaluated.**
2. **Phosphorus-containing materials are most practical and effective of those materials tested.**
3. **Possible side-effects of preignition additives, such as reduced valve life, intake-system deposits, and increased octane requirements need thorough investigation in laboratory and in service.**
4. **Close cooperation is needed between the engine manufacturer and fuel refiner to insure that preignition does not become a limiting factor in future high-compression engines.**

How Effective Are Gasoline Additives?

F. C. Burk, L. J. Test, and H. R. Jackson,
The Atlantic Refining Company,
Philadelphia

THE EFFECT OF increasing the compression ratio of cars on the octane level of commercial fuel, required to prevent objectionable knock, has been under continuous study for many years. Higher compression-ratio engines and higher octane fuels have resulted. However, an increase in the compression ratio brings on other problems in addition to detonation. Two of these problems are preignition and spark-plug fouling.

In this discussion the word "preignition" is defined as ignition of the charge by particles in the combustion chamber prior to ignition by the spark.

Oven Tests—A laboratory oven was set up so its temperature could be increased from 100 to 1100 F. at the rate of 4° per minute. Porcelain boats containing definite amounts of deposit are placed in the oven with a thermocouple in each boat. The oven temperature then is increased at the prescribed rate, and deposit temperatures are recorded. A sudden increase in temperature in any of the deposits indicates a burning point, and is taken as a measure of the preignition tendency of the deposit. Examples of such temperature charts are shown in Figures 1 and 2. Figure 1 is a temperature-vs.-time chart in which the solid line represents the oven temperature itself, and the dotted line represents the temperature of the deposit in the porcelain dish in the oven. Note that the temperature of the deposit lags behind that of the oven because of the insulation effect of the deposit surrounding the thermocouple in the porcelain boat. However, when the deposit reaches its ignition or glow temperature, which in this case was 695 F., there is a sharp and definite increase in the deposit temperature, such that it well exceeds the temperature of the oven. Once the combustible material in the deposit has burned out, the temperature curve drops back and follows its original slope.

Figure 2 represents the type of data obtained for four samples—one always a standard—in the oven on one run. As may be seen, the glow points of these 4 deposits varied from 450 to 900 F.

Single-Cylinder Engine Tests—Although this oven test is reproducible, short, and appears to be satisfactory for screen purposes, it was necessary to tie it in with preignition tests made in an actual engine. At the time the first oven work was undertaken test methods also were being developed using a single-cylinder L-head ASTM CFR engine to study preignition. This engine uses a cycling procedure similar to that described by the Ethyl Corporation,[2] except that the individual deposit-forming and preigniting cycles are much longer, and the total test length is considerably shorter. An electronic counter is used to measure the average number of times the engine preignites per hour. Details of the procedure are given in Appendix A.

A number of fuel additives were evaluated in this engine in terms of average preignition counts per hour. Combustion-chamber deposits were removed at the end of each test, and each deposit was tested in the oven for "glow point." Figure 3 shows the correlation between the oven glow-point temperatures of these deposits and the average number of preignitions per hour which they caused. High glow points appear to be related to reduced engine-preignition tendencies as shown by low counts per hour. On the basis of this correlation the oven test was considered a useful bench test.

Early experiments with the oven, outlined in Table 1, showed that carbon alone glowed at a fairly high temperature, and that the simple lead salts normally found in engine deposits did not burn at all. The combination of these lead salts with carbon resulted in a variety of glow-point temperatures. The lead-oxide-carbon mixtures gave even lower glow points than either carbon or lead oxide

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alone. This is in agreement with data reported by other investigators.[1] Of the lead-salt-carbon mixtures tested the lead-phosphate-carbon mixtures gave the highest glow-point temperatures. To study the effect of the lead oxide to carbon ratio the glow points of various mixtures of lead monoxide and carbon black were determined in the oven. The data, which are given in Table 2, show that 80 to 90 percent of lead monoxide in carbon black resulted in the lowest glow temperature. Based on this work a procedure was developed in which synthetic deposits were made from lead monoxide and carbon black. Potential fuel additives were combined with these synthetic deposits and were evaluated for preignition tendencies in the oven. This procedure is described in Appendix B.

Promising additives—i.e., those giving high glow-point temperatures in the oven test—are evaluated in the CFR engine. This engine procedure has proved to be quite valuable in our work because it is short (22 hours) and fairly reproducible (±10 percent). Examples of how it ties in with oven tests are shown herein in Figure 3. The next step was to see how the single-cylinder-engine tests correlate with multicylinder-engine tests.

Laboratory Multicylinder-Engine Tests—Passenger-car engines on dynamometer stands have been used in our laboratory to study the effect of combustion-chamber deposit buildup on the fuel octane requirements of these engines. It was found that, by slight modifications to the test procedure used in this work, the preignition tendencies of the deposits could be studied. A description of the procedure used is given in Appendix C. This type of test has the disadvantage that about 250 operating hours are required for a single preignition evaluation. Typical results for these tests, as well as for the CFR preignition test and the oven test, are shown in Figure 4. This bar graph shows the correlation among the oven test, single-cylinder CFR engine test, and full-scale laboratory engine test. On this and on subsequent charts, in which percent effectiveness of additives is compared, percent effectiveness is determined as follows:

- For the oven test 0-percent effectiveness was defined as the average glow point of CFR-engine deposits obtained from tests using a reference gasoline. This reference gasoline contained 3 ml tetraethyllead per gallon and no preignition additive. One-hundred-percent effectiveness is defined as the glow point of pure carbon.
- For the engine and road tests 0-percent effectiveness was defined as the performance of the test fuel containing 3 ml tetraethyllead per gallon and no other additives. One-hundred-percent effectiveness is defined as the complete absence of preignition.

Controlled Road Tests—The next step in our preignition evaluation is with controlled road tests. Two types of driving are employed in these tests: city, of the stop-start type; and high-speed, or turnpike, type. The techniques used to study preignition in the road-test cars are given in Appendix D. They are similar to those used in the engine-dynamometer tests. The city program was run in two phases. During the first phase oil consumption was high, and the cars were inclined to preignite. In the second phase, after the engines were well broken in, lower oil consumption resulted, and less preignition was encountered. Figure 5 shows results on some of the additives used throughout the program. The deposits formed at high speeds must differ from those accumulated at low speeds in amount and/or type because they are much less disposed to cause preignition. In the city tests oil consumption appeared to be a factor because the compounds varied in their effectiveness in reducing preignition in these cars. However, the results tend to line up with those obtained in the laboratory tests.

The final phase of preignition testing is carried out in cars in customer service. Although these tests are under way, the results are not ready for reporting at this time.

Spark-Plug Fouling Tests—Thus far no mention has been made of spark-plug fouling test procedures. They are important. However, at present no bench or short-time engine tests at Atlantic have demonstrated successfully differences between additives. Although spark-plug performance has been studied in the multicylinder labo-

TABLE 1
Glow-Point Temperatures of Synthetic Deposits as Determined in an Electric Oven

Substance:	Glow-Point Temperature (°F.)
Carbon black	735
Lead salt found in engine deposits:	
Lead monoxide	> 1,200
Lead sulfate	> 1,200
Lead orthophosphate	> 1,200
Lead nitrate	> 1,200
85 percent lead oxide + 15 percent carbon black	580 to 585
85 percent lead nitrate + 15 percent carbon black	690
85 percent lead sulfate + 15 percent carbon black	840
85 percent lead orthophosphate + 15 percent carbon black	850
85 percent (lead oxide + lead sulfate) + 15 percent carbon black	650 to 657

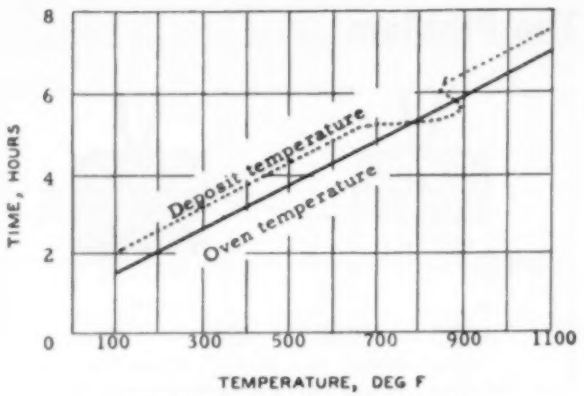

Figure 1. Simplified oven glow-point chart.

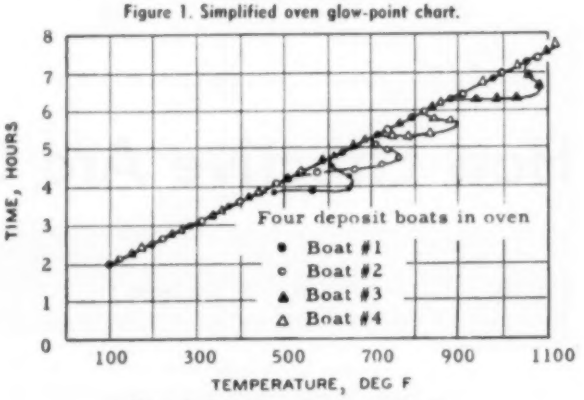

Figure 2. Typical oven glow-point chart.

TABLE 2
Synthetic Deposits Showing Effect of Lead Oxide to Carbon Ratio on Glow Point

Substance:	Glow-Point Temperature (°F.)
100 percent lead oxide	> 1,200
90 percent lead oxide + 10 percent carbon black	585
80 percent lead oxide + 20 percent carbon black	580
60 percent lead oxide + 40 percent carbon black	620
40 percent lead oxide + 60 percent carbon black	670
100 percent carbon black	735

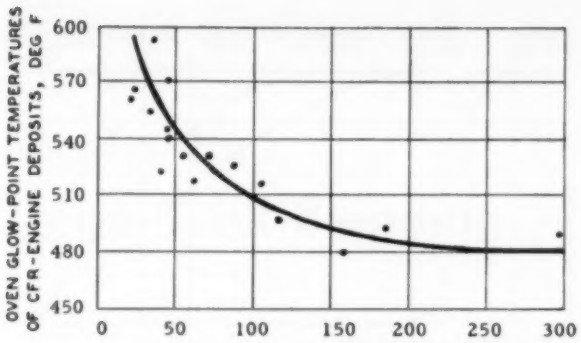

Figure 3. Correlation between oven and CFR-engine tests.

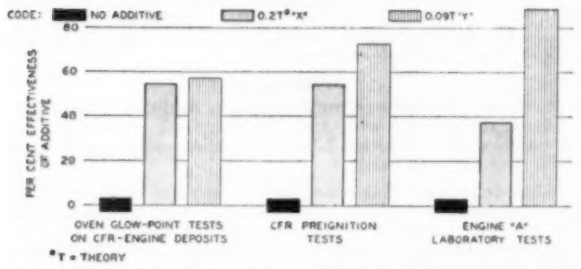

Figure 4. Performance of preignition additives in various laboratory tests.

ratory engines and in the controlled road-test cars by power-loss measurements with new and used plugs and with an ignition analyzer, very little plug fouling has been found in these tests. It is apparent that longer hours and miles of operation are required before appreciable plug fouling becomes evident.

Additives—Other authors have pointed out that certain phosphorus compounds, when added to gasoline in small quantities, help to reduce preignition and spark-plug fouling difficulties. An explanation given is that the conversion of lead oxides to lead phosphates occurs in the combustion chamber, the latter lead compounds being less harmful than the lead oxides. The amount of these phosphorus compounds added to the fuel is based on the amount of phosphorus needed for this conversion, and is expressed in theories. One theory of such a compound contains enough phosphorus theoretically to convert all the tetraethyllead in the gasoline to lead orthophosphate. Most investigators have conducted experiments employing phosphorus additives at the 0.2-theory level with 3 ml tetraethyllead per gallon in the fuel.

Now that the procedures used at Atlantic to evaluate the effectiveness of preignition additives have been discussed, it is time to turn to results with various types of compounds. The work on preignition compounds can be divided into two major classes: (1) organic phosphorus compounds; and (2) non-phosphorus additives. Preliminary work in many cases was carried out using the oven test. However, all promising materials were run in the CFR preignition engine.

Phosphorus additives—By far most of the compounds tested have contained phosphorus. It was found that the chemical structure of the phosphorus compound has a tremendous influence on preignition control. For example, 0.2 theory of one phosphate reduced the number of preignitions per hour by 40 percent, whereas 0.2 theory of another phosphate reduced preignition by 90 percent. In addition to phosphates other phosphorus-containing compounds have been evaluated. These data indicate that there may be wide differences, from the standpoint of preignition effectiveness, among the individual members of any particular class of phosphorus compounds.

Non-phosphorus additives—Although a number of non-phosphorus additives have been found to reduce preignition in the CFR test, it appears that phosphorus-containing materials, for the present, are most practical and at the same time very effective. With the realization that many phosphorus materials are pro-knock agents and may reduce exhaust-valve life, it is felt that, because future high-compression engines may require up to 1 or 2 theories of phosphorus for preignition control, other materials may be more suitable. Such other materials are metallic salts, other non-metal compounds, or combinations of these; and they are being investigated.

Side Effects of Preignition Additives—Possible side effects can be encountered in the use of preignition additives as follow: (1) lowering of fuel octane by lead antagonism; (2) reduced exhaust-valve life; (3) increase in the octane requirement of the engine; (4) increased engine varnish; and (5) increased intake-port and -valve deposits. All of these side effects should be studied thoroughly for each additive which may be considered for use as an effective preignition or spark-plug fouling fuel additive.

Dependent on Operating Conditions and Engine Design—Figure 6 shows the relative performance of a base fuel (3 ml tetraethyllead) and 5 different additive combinations under different operating conditions and in different types of engines. The ordinate on this chart shows the per-cent effectiveness of the additives, similar to previous charts. The data on the additives, as evaluated in each specific test procedure, are plotted on vertical lines at various "severity" levels, as shown along the abscissa. This severity factor introduced to show that, depending on the equipment and operation selected for evaluation, typical additives at typical concentrations can appear to be not even needed at one extreme, and not effective at the other. Based on our observations of many cars in normal service, it is felt that most cars on the road belong on the mild section of this chart. However, certain late-model cars already have progressed toward the severe side. Inasmuch as the petroleum industry is prepared to produce even higher octane-number fuels, and inasmuch as the automotive industry has been encouraged to increase compression ratios still further to use these fuels efficiently, it is apparent that both these industries must consider jointly the preignition and spark-plug fouling problems in future engines.

Summary—(1) Various laboratory tests can be used to predict the relative road performance of preignition additives.

(2) Of the many types of preignition additives tested, the phosphates were the most effective.

(3) The possible side effects of preignition additives, such as reduced valve life, intake-system deposits, and increased octane requirement should be investigated thoroughly both in laboratory and in service.

(4) The apparent need for, and effectiveness of, various preignition additives is dependent on the severity of both the engine and operating conditions under which they are evaluated.

(5) Close cooperation is needed between the engine

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Effectiveness of Additives . . .

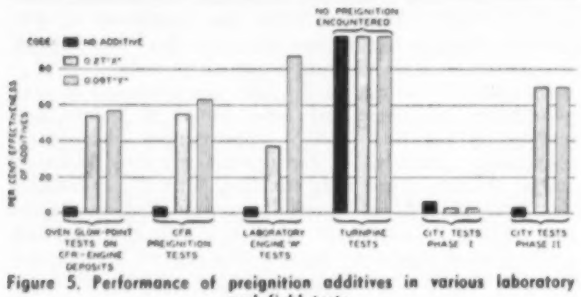

Figure 5. Performance of preignition additives in various laboratory and field tests.

manufacturer and the fuel refiner to insure that preignition does not become the limiting factor in future high-compression-ratio engines.

ACKNOWLEDGMENT

Acknowledgment is made to W. R. Miller, B. L. Hurd, A. Cowell, J. Savin, and T. Demuth of the automotive laboratory, research and development department, for their contributions to the development of techniques and for their interest in obtaining the data reported herein.

REFERENCES

[1] J. R. Sabina, J. J. Mikita, and M. H. Campbell, "Pre-Ignition in Automotive Engines," Proc. *API* 33 **[III]** 137-150 (1953).

[2] D. A. Hirshcher, J. D. McCullough, C. A. Hall, "Deposit Induced Ignition," presented to the Socy. of Automotive Engineers at Detroit, June, 1953.

APPENDIX A

Preignition Test Procedure for CFR L-Head Engine (Compression ratio, 7:1. Test continued for 22 hours.)

	Time (Hours)	Water Outlet Temperature (°F.)	Oil Temperature (°F.)	Intake Manifold Pressure (Inches of Mercury)	Speed (RPM)	Air-Fuel Ratio
Deposit-forming	1	70	135	20	685	11.0
Preigniting	1	190	150	30	900	13.0

Fuel: 60 percent catalytically cracked. 40 percent straight run. 3 ml tetraethyllead per gallon. 0.4 percent lubricating oil.*

Lubricating Oil: SAE 40 solvent-refined base.

* Oil consumption appears to affect combustion-chamber deposits and preignition. Therefore, 0.4 percent lubricating oil was added to the test fuel in order to compensate for the low oil consumption of the CFR test engine in relation to passenger-car engines.

APPENDIX B

Preparation of Synthetic Deposits for Oven Glow-Point Test

Lead monoxide plus various concentrations of the preignition additive are mixed intimately in a porcelain crucible, ignited, and burned over a Meeker burner. The resultant ash is heated at 1000 F. for 4 hours in a muffle furnace. This complex lead salt then is ground with 15 percent carbon black in a mortar and pestle. This final material is packed in the porcelain boat with the imbedded thermocouple, and the glow point is determined.

In the case of actual engine deposits representative combustion-chamber deposits are removed and are placed in the glow-point boats directly. The glow point is determined from the chart of temperature vs. time, and is the point at which the curve starts to show a rapid change in slope.

APPENDIX C

Engine A Combustion-Deposit Test Operating Conditions for Deposit Buildup

Temperature, °F.:		
Jacket out		160
Jacket in		150
Oil sump		160
Cycle (deposition phase):	Low	High
Speed, rpm	600	2,000
Time distribution, minutes	1	3
Load, brake horsepower	0	10
Length of test (to octane requirement equilibrium), hours	200 to 300	
Spark setting (factory), deg before top center at 500 rpm		5
Oil fill, quarts		4
Oil change, hours of operation		50

Fuel composition: Commercial fuel containing 3 ml tetraethyllead per gallon.

Oil composition: SAE 20 premium-grade oil.

Operating conditions to obtain octane requirement (obtained daily):

Speed, rpm	1,000
Load, brake horsepower	Full throttle, full load
Spark setting (factory), deg btc (basic setting, 5 deg btc at 500 rpm)	14
Jacket-out temperature, deg F.	160
Air-fuel ratio	12.5:1

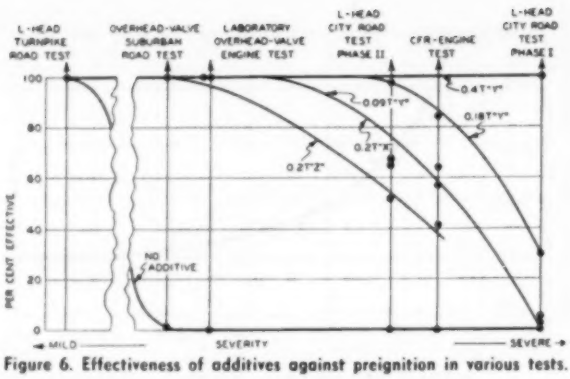

Figure 6. Effectiveness of additives against preignition in various tests.

Engine "A" preignition-rating operating conditions:

Same as the foregoing except spark timing is retarded 10° from factory (basic setting, 5° btc at 500 rpm).

A 10° spark retardation drops the requirement of this engine approximately 15 research octane numbers in the complete absence of preignition. A drop of less than 15 numbers indicates the presence of preignition. When no drop in requirement has been found, the engine is said to be preignition-limited.

APPENDIX D

Road-Test Procedures for Preignition Additive Evaluation

Fuel, commercial with 3 ml tetraethyllead per gallon; oil, premium-grade; vehicle, L-head 8-cylinder-in-line engine of 7.0:1 compression ratio.

City Schedule—This schedule was operated on a two-shift-per-day basis. A test course 23 miles in length, and consisting of city and suburban driving in the Philadelphia area, was employed. Maximum speeds were 30 mph to 35 mph, and the average speed was 17 mph.

The cars, which started with clean combustion chambers, were run to 2,500 deposit miles. Power, knock, and preignition ratings were made every 830 miles.

Turnpike Schedule—This schedule was operated on a two-shift-per-day basis. A test course 380 miles in length, and consisting mainly of high-speed Pennsylvania Turnpike driving, was employed. The maximum speed was 70 mph, and the average speed was 50 mph. The cars, which started with reconditioned engines, were run for 10,000 miles. Periodic performance ratings, including preignition, were made during the test, and the engines were torn down at the end of the test for valve-burning, deposits, and wear determinations.

Rating Procedures—The procedure which was most useful in the rating of preignition tendency was to compare the retarded-spark octane requirement with the standard-spark requirement. Instances in which the retarded requirement was normal—approximately 1.5 octane numbers lower per degree of basic spark retardation—were judged indicative of no preignition, and cases in which the retarded requirement was close to, equal to, or higher than the standard spark requirement indicated varying amounts of deposit ignition. Octane requirements were determined on the chassis dynamometer with level-road load accelerations from 10 to 50 mph in high gear. The normal- and retarded-spark requirements were obtained by rating all knock—normal or preignition-induced. Preignition noise is in most cases erratic, and the retarded-spark requirements were taken as the primary reference fuel which would give trace knock on half the accelerations. In the case of the particular L-head engine used, preignition-induced knock is rather easily distinguished aurally from normal knock by difference in sound, intensity, speed range, inconsistency, and tendency to knock on only one cycle. For 2500-mile deposit accumulation, preignition knock seldom occurred during the standard spark requirement determination.

Spark-plug fouling was rated by comparison of road horsepower on the used plugs with that on a standard set of new plugs at 50 and 65 mph in high gear, and at 45 mph in second gear. Power losses caused by plug fouling were found to be greater at higher engine speeds. An ignition analyzer (modified oscillograph) was used to observe coil voltage patterns for plug malfunctions, particularly shorting by deposits.

Compression-pressure readings were taken as an indication of valve performance. In the case of the turnpike-operated cars, low compression pressures which resulted from both exhaust- and intake-valve burning was found with some of the additives which were tested.

Original presentation was before the 19th Annual Mid-Year Meeting, API Division of Refining, May, 1954.

Design and operation of . . .

Mixers for Large Tank Blending

Presenting for the first time anywhere a complete analysis of the theory and techniques of large tank blending operations.

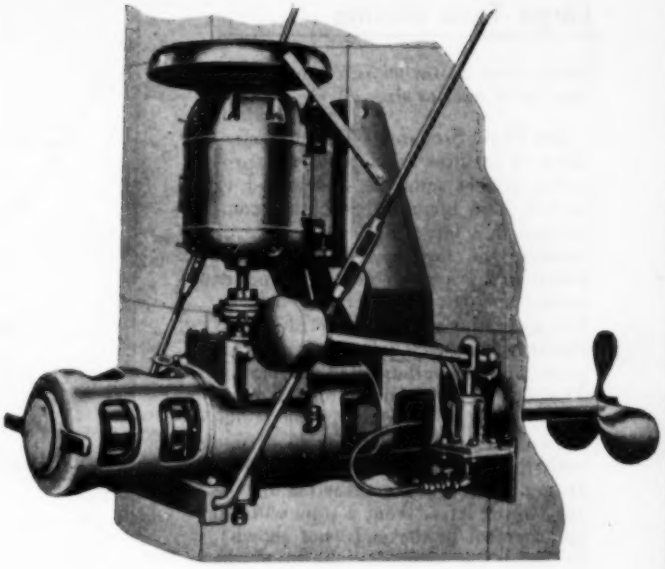

Figure 1. Side-entering propeller mixer in tank.

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BLENDING operations in the petroleum industry, pose many problems. For example, tetraethyl lead is mixed with gasoline to increase octane number, various heavy naphtha cuts are blended to give heater oils, additives are combined with lubricating oils to improve their properties. These operations are often performed in large tanks—from 20 to 150 feet in diameter. The most common form of mechanical mixer in use is the marine-type propeller (Figure 1) operated by a shaft entering through the side wall of the tank. These are called "side-entering mixers."

Mixing in large tanks has been accomplished in a variety of ways, the most common of which has been to recirculate liquid in the tank by withdrawing it to the suction of a pump and then returning the pump discharge stream to the tank. The return may enter the tank through a "spider" pipe at the bottom; through a swing line from near the top; or simply from a pipe or nozzle located at or near the bottom of the tank. Since these techniques usually require long operating time to achieve a satisfactory blend, side-entering propellers have been used extensively in recent years to minimize the blending time and power required. Data are available to compare performance of blending by recirculation with an outside pump and by recirculation within the tank by a side-entering mixer. Mixing by these means can be explained by fluid mechanics theory, and a discussion of the behavior of mixing streams in large tanks will be given.

Mixing by Natural Diffusion—If two miscible liquids are placed one above the other they will gradually intermix due to the diffusion (or natural convection) of the molecules. Such mixing may take place very slowly. The function of a mixer is to provide forced convection so that the intermingling will take place rapidly. To illustrate the slowness of natural diffusion of one liquid in another, test data are shown in Figure 2 of the temperature changes in a 5-foot diameter steel tank filled with water to a depth of 5 feet. The water in the lower two-thirds of the tank was 75 F., and in the upper one-third was 123 F. at the start of the readings. The tank stood quietly and without any agitation. The temperature-time history is plotted in Figure 2, next page, for each of the four temperature measuring points. It is remarkable how slowly the temperatures changed, and even at the end of 24 hours there was still a difference of 7 F. between the top and bottom of the water. A small amount of energy properly applied by means of a mixer would have blended this hot and cold water in a few minutes time.

Mixing by Forced Convection—There is no uniform criteria for mixing, but for blending operations a suitable criteria is the degree of homogeneity and the time required to attain it. Mixing is accomplished by turbulent entrainment of one liquid in another.[1,4] In large tank blending operations, the turbulence is generated by liquid velocity discontinuities. When two fluid streams adjacent to each other move at different velocities, a shear stress is set up, and when this stress is sufficient to overcome the viscosity, the flow line is deformed and eddy motion is initiated. This eddy motion spreads throughout the flowing stream causing turbulence and mixing.

To blend in large tanks it is necessary to bring large quantities of liquid into turbulent areas, and this is accomplished by causing circulation of liquid to all parts of the tank so that all the liquid will be brought into contact with an eddy forming flow discontinuity. When the high velocity liquid stream generates eddies, material from the low velocity areas is entrained into the high velocity stream. Turbulence in the stream then mixes the entrained liquid. The turbulent stream will expand in size; its velocities will decrease due to transfer of momentum and energy, and at some point it will cease to cause further entrainment. The rate at which all liquid in a tank can be entrained, together with the amount of turbulence in the stream, will determine the rate at which homogeneity or blending can be accomplished.

Fluid streams in large tanks can be formed either by a rotating mixing impeller (Figure 1) or by an external pump used to produce a jet of liquid as it discharges through a pipe or nozzle. Pipes or nozzles vary in size from 12 to 1 inch in diameter in large tanks. The mixing propellers are seldom

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larger than 28 inches in diameter and may be of smaller size.

Jet Flow Streams—The characteristics of jet flow from pipes and propeller mixers must be understood to realize how blending can be accomplished in a large tank. Regardless of whether the flow is produced by a pump or by a side-entering propeller mixer, the stream emerging behaves like a circular submerged jet. Figure 3 illustrates the flow jets resulting from pipes and propellers used in mixing. The jet may originate in one of many ways: from a simple pipe as at the upper left of the figure, from a pipe with the end inclined (upper right), from a pipe with a contraction or nozzle (lower left), from a pipe with an enlargement at the end (not shown), or from the propeller shown at the lower right. In each of these jets, the high velocity fluid causes entrainment, whereupon the stream expands and turbulence spreads the entrained liquid throughout the jet.

The amount of liquid entrained by a jet stream may be determined by the equation:

$$Q_e = \left[0.23 \left(\frac{X}{D_o} \right) - 1 \right] Q \qquad (1)$$

Where Q is the quantity of liquid at the origin of the jet, Q_e is the amount entrained in the distance X along the axis of the expanding jet, and D_o is the diameter of the jet at its origin.

It has been shown[1] that the most economical use of kinetic energy of flow for entrainment in a given distance X occurs when $(X/D_o) = 17.1$. This is not to say that streams will not entrain for greater distances, but the best economy occurs at 17.1 jet diameters. The distance over which a jet will entrain may be as high as 80 to 100 diameters, and depends upon the velocity of the jet. No data are available to determine the distance in which a jet will entrain, but some work is in progress to find how far they do entrain in tanks. Since the optimum entrainment for a given distance, per unit of energy, occurs at about 17 jet diameters it is obvious that large diameter jets should be used in large diameter tanks for best power economy. In practice, propellers of 2 and 2½-foot diameter are used in tanks of 50-foot diameter and larger.

Flow from Propellers—There is one major difference in the flow stream from a propeller and from a pipe or nozzle. The jet from a nozzle has its principal flow in an axial direction, and in addition contains a small amount of turbulent flow in all directions. The jet from a propeller not only has a flow in the axial direction together with turbulence, but also has a rotary (spiral when considered with the axial component) flow due to the torque exerted by the blades of the propeller. Thus, the flow from a three-bladed propeller may be thought of as starting with a path traced by a three strand rope.

The spiral flow is available for mixing, and may even affect the entrainment rate, but this latter effect has not yet been determined. The three basic flows—axial, rotary, turbulent—of a propeller stream can be resolved into components in the axial direction and in a plane perpendicular to the axis. These are referred to hereafter as axial-flows and non-axial flows.

Both the nozzle jet and the propeller jet have axial and non-axial flow components, but due to the rotary spiralling action of the propeller jet, it has much more flow motion in the non-axial direction. The difference in the ratio of axial and non-axial flow motion is believed to account for the principal differences in mixing characteristics between nozzle and propeller mixing. The energy and power in the stream can be apportioned to the axial and non-axial components by the use of the velocity heads in each sense.

Flow from marine-type propellers cannot easily be measured, but data are available for such propellers. The flow from such propellers can be determined from

$$Q = K N D^3 \qquad (2)$$

where Q is the flow in cubic feet per second, K the value[4] of 0.40 for water at 70 F., N is revolutions per second, and D is the propeller diameter in feet. By use of this equation the flow can be obtained for use in Equation (1).

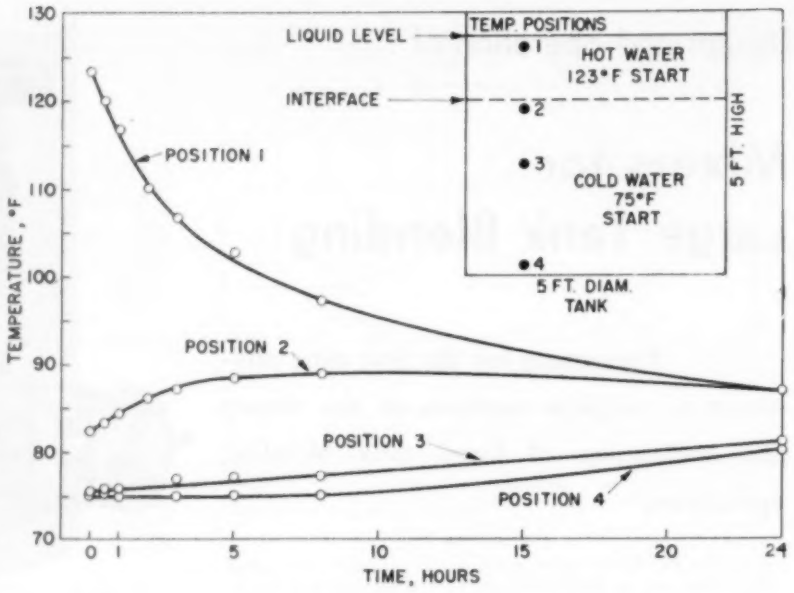

Figure 2. Natural diffusion in a 700-gallon tank.

The power required to produce flow from a pipe or nozzle can be determined from

$$P = \rho Q H \qquad (3)$$

where P is the power in foot pounds per second, ρ the density in pounds per cubic foot, and H is the total head (feet) against which the flow takes place. At the jet origin the total head is the sum of the velocity head and the turbulent heads present. The axial velocity head is $(\bar{u}^2/2g)$, and the turbulent head is proportional to $(\overline{u'^2}/2g)$, where $\bar{u}$ is the average axial velocity, and u′ is the velocity fluctuation as defined by the equation for instantaneous velocity u,

$$u = \bar{u} + u' \qquad (4)$$

The turbulence is a function of the root mean square of u′, or $\sqrt{\overline{u'^2}}$. Furthermore, the instantaneous velocity fluctuations in a plane perpendicular to the axis can be shown to be a function of $\sqrt{\overline{u'^2}}$, hence the velocity fluctuation u′ in the axial direction can be correlated with turbulence and the velocities in the non-axial flow.

The power required to produce the jet flow from a propeller properly mounted (see Figure 4) is determined from

$$P = \frac{K}{g_c} \rho N^3 D^5 \qquad (5)$$

g_c is the gravity constant. The value of the constant K for one type of square pitch propeller is 0.32.

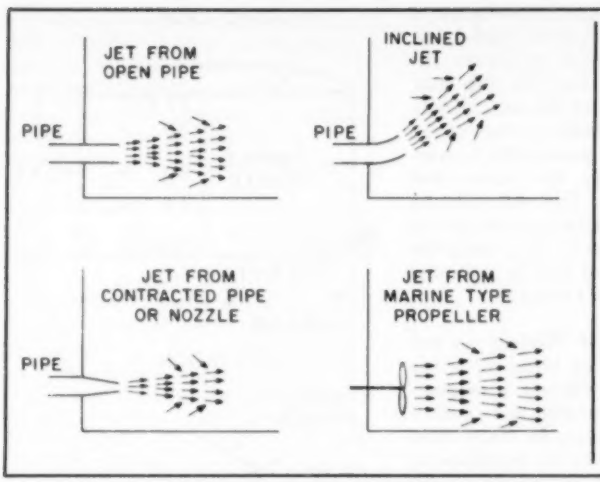

Figure 3. Entraining mixing jets.

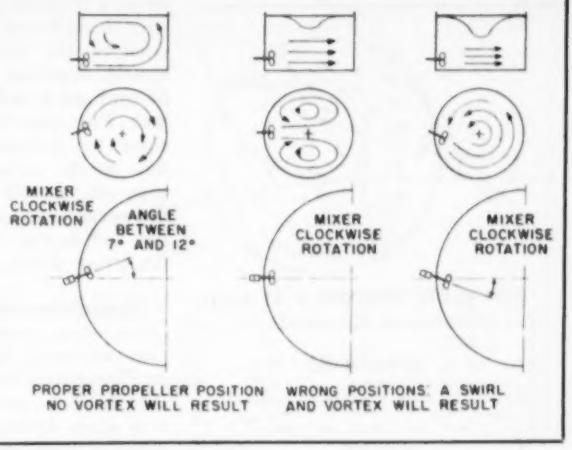

Figure 4. Introducing liquid during mixer operation.

Also, the power in the propeller flow is as shown in Equation (3), and the head H is the sum of the axial velocity head and the turbulent and rotational heads. For simplicity in this discussion the total head may be thought of as the sum of the axial and non-axial heads. Flow from propellers always has a lower ratio of axial to non-axial flow energy or power than does a pure jet.

Mechanism of Mixing—Since the amount of entrainment, spiral motion, and turbulence will determine how rapidly mixing and blending takes place, the amount of liquid moving at the jet and the power required to move it, are data which can be used to determine relative mixing performance of flowing streams. It should be noted that the optimum use of power for entrainment occurs when the jet diameter is $1/17$ of the distance over which entrainment is desired. However, such a criteria pertains only to the amount of liquid entrained.

The turbulence and rotary motion in the jet stream at its origin will vary, and will affect the rate at which the jet is homogenized. It is clear that small diameter jets entrain more material than large diameter jets for the same total rate of flow and for the same entraining distance, but small jets are much less efficient for use of power in large tanks, both because the optimum entraining distance for the small jet is so low and for the fact that if many small jets are used, a complicated distributing system will require excessive power.

Regardless of whether blending is to be accomplished by recirculating liquid through a pump and returning to the tank through a pipe, or whether it is accomplished by a side-entering propeller mixer, the mechanism of blending is the same. Thus, a submerged fluid jet is caused to flow and this jet entrains and mixes the liquids. The most pertinent discussion of the theory of jets applying directly to this problem has been by Folsum and Ferguson.[1] Fossett[2,3] has published results of experiments using constricted pipes or nozzles and has presented data in terms of mixing time. Fossett's data are the only ones available in the literature to show how rapidly blending can be accomplished by the use of jets produced by external pumps. Some of Fossett's data will be cited here for comparison with the performance of side-entering propeller mixers.

Side-Entering Propeller Mixer—When a side-entering propeller mixer is used, the propeller is close to the side of the tank, and its shaft is horizontal (Figure 1). Figure 4 shows flow patterns which will result for a propeller turning clockwise, looking from motor to propeller. The diagrams at the top of the figure show the over-all pattern of fluid motion in elevation. The diagrams below show the plan view of the gross flow motion, and the lowest diagrams show three different positions of the side-entering propeller. The diagram at left shows proper propeller position for rapid mixing.

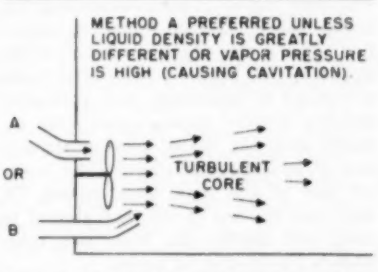

Figure 5. Side-entering propeller mixer position.

The propeller shaft must be off-center so that the angle between the shaft and the diameter lies between 7 and 12 degrees. When in this position, the flow patterns shown in the two diagrams above will result, and it should be noted that there is no vortex formed in the surface of the liquid and no large size swirl produced. If the mixer is placed in any other position than the one shown at the left, either on the diameter or the wrong side of the diameter, the two conditions shown at the right will result. The elevation views show fluid rotating around a vortex and the plan views show the same effect. In the middle position there are two large vortexes with swirling around each, whereas on the right hand pictures there is only one deep vortex and all the liquid swirls around it. The two situations pictured at the right are not conducive to rapid mixing, whereas the one on the left is conducive to rapid mixing.

Equation (4) shows the power required to turn a propeller, but it applies only with the propeller in the position shown at the left of Figure 4. Whenever there is a large swirl in a tank, the propeller power will be less for the same rate of rotation. The discharge flow from a propeller as shown in Equation (2) applies only in the position shown at the left of Figure 4.

Circulating liquid flowing from a pipe will behave similarly to the right hand diagrams of Figure 4. If the opening is inclined as shown in Figure 3 (upper right) there will be less swirling than if the jet is parallel to the surface. Pipes or nozzles for jet mixing are usually brought into a tank to discharge along a tank diameter, and the general flow pattern is similar to that shown in the middle position of Figure 4, but with less vortex when

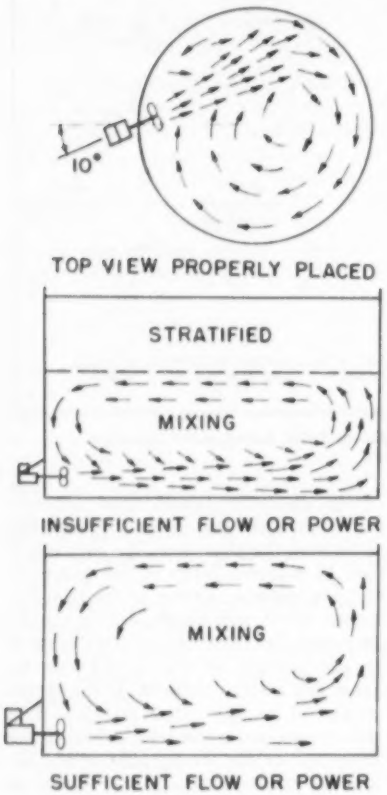

Figure 6. Flow from a mixer or a jet properly placed.

the jet is inclined upwards.

If a liquid is to be added for blending during operation of a propeller mixer, the recommended method of introduction is shown in Figure 5. Preferably, the added material should be brought to the middle of the jet. When this is done, the induced flow will be mixed with the addition material by turbulence within the jet. To accomplish such addition, method A, Figure 5 is used unless there is some reason for not doing so. Method A consists of causing the added material to flow into the propeller and thus be a part of the turbulent core of the jet. If, however, the added liquid has a low vapor pressure, cavitation and flashing may occur at the propeller and it may then be necessary to add as shown at B., in front of the propeller. A very dense liquid should be added behind the propeller, and preferably from the top. If it were added in large quantities at A, the propeller might become overloaded, because the power demand is proportional to density (Equation 4).

Liquids may remain stratified to some extent if there is insufficient power in the mixing stream, or if the flow pattern is improper. Figure 6 shows a propeller properly placed, but with insufficient flow or power exerted by the propeller, the top may remain stratified, and the mixing may be confined to the lower portion of the tank. For propeller mixers this is overcome by increasing the power and flow at the mixer. For recirculating pipe jets, stratification is overcome in the same way, namely, increasing the flow and power, and also by inclining the jet as shown in Figure 2.

Measurement of Mixing—A criterion often used for blending is the time necessary to achieve homogeneity. Sometimes homogeneity is a difficult thing to measure. In large tanks it is often determined by withdrawing samples from strategic points at different depths and comparing the composition by some simple property. Examples cited here use API gravity for the blending of heating oils, and TEL content for adding tetraethyl lead to gasoline.

Examples of the time required to mix petroleum hydrocarbons are taken from data in the literature and from field data at several refineries. Data for nozzle jets are from Fossett and Prosser[2] and the data on side-entering mixers are from the Standard Oil Company (Indiana), and the files of Mixing Equipment Company, Rochester, N. Y.

Mixing Stratified Oils—Data for mixing of a furnace oil in a 20,000-barrel tank shown in Figure 7 are plotted in Figure 8. Five sample points at different elevations are used. The tank was 65 feet in diameter and filled to a depth of approximately 40 feet with four different oils whose properties are shown in Figure 8. After the tank was filled, it was allowed to stand quietly for several hours at which time API gravity was determined at the five levels. The mixer was then started and operated until the API gravity of all five levels was the same. The time to reach homogeneity indicated by uniform density was the measure of mixing.

The plot of Figure 8 shows that for this stratified tank, the lower 22 feet was well mixed in four hours, but the levels above 22 feet remained stratified. This is the situation shown in the upper left of Figure 6. The mixer was continued in operation and gradually the low density upper layers were induced into the lower flowing stream, and after about eight hours, the lower 30 feet of the tank were mixed. By this time the top of the tank started to mix, and finally the tank was completely blended in 12 hours.

This example is presented to show

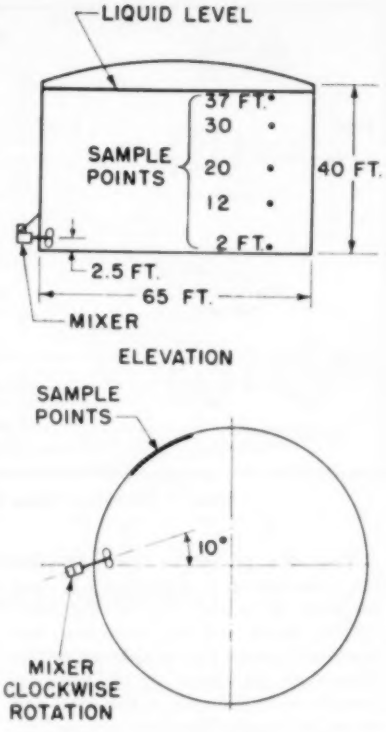

Figure 7. Location of mixer in 20,000-barrel tank showing sample points.

the general behavior of fluid motion and entrainment in a large tank. The lower portions of the liquid were set in motion first and by momentum exchange and entrainment the upper layers were gradually brought into the mixing stream. The nominal 10-hp mixer used a 24-inch propeller running at 420 rpm. The power impressed was 9.6 hp per hour and the flow from the propeller was 10,000 gpm. This rate of flow and power level (0.48 hp per 1000 barrels) was not sufficient to produce a rapid blend and the total power consumption was 115-hp hours. To blend the same tank in three hours, a nominal 15-hp mixer (26-inch propeller running at 420 rpm) would be used. This mixer would deliver 14 hp at the propeller and discharge 13,000 gpm. The power level would be 0.7 hp per 1000 barrels and total power consumption would be 36-hp hours. This 30 percent increase in power and flow from the larger mixer results in a decrease in blending time from 12 hours to 3 hours. The gravity difference of the liquids in this mixture is relatively high and thus a relatively high power level is required for rapid blending.

Mixing with Nozzles—Fossett and Prosser[2] in England, made a number of tests on blending of hydrocarbons

by circulation with an external pump and injecting thru a nozzle, without the use of side-entering mixers. To measure the blending of TEL in gasoline, they took samples at different levels as time progressed and continued mixing until all levels showed the same TEL content. For one run in a 38,000-barrel tank they give complete data, which are here plotted in Figure 9. The TEL concentration in Figure 9 is in units of cc's of TEL per Imperial gallon. The method of mixing consisted of recirculating about 600 gallons (U. S.) per minute from the tank through a circulating pump and back to the tank through a pipe at the end of which were two nozzles in the form of a Y. The nozzles were each 1.75 inches in diameter, and were inclined up from the horizontal 20 degrees. The flow through each jet was 0.7 cubic feet per second. Tetraethyl lead was drawn into the circulating line from drums using an eductor pump. The tank was 118 feet in diameter and filled to about 20 feet with gasoline before the TEL addition and mixing. After the addition of TEL (8.5 hours) recirculation was continued until the tank was mixed, a total 10.5 hours.

Concentrations at the three sample levels are plotted against time in Figure 9. It is clear that mixing was being accomplished during the entire 10.5 hours, for the TEL concentration continually increased at the higher levels.

The power used for this mixing can be calculated from the velocity head and the quantity of liquid pumped. It appears that the kinetic energy along the axis of the jet at the nozzle amounted to 3.8 hp, corresponding to 0.1 hp per 1000 barrels. Thus this operation required a total of 3.8 hp for 10.5 hours, or 40-hp hours. This was exclusive of the power required to overcome pressure drop in the lines and fittings. Fossett and Prosser give no data on the power required to overcome the friction in the circulating pipe line, but such power is appreciable and should be accounted for.

Fossett states that this same tank and quantities had been blended by recirculating as just described except that a "normal spider" (pipes in the tank bottom with small holes through which many jets were sent upward) was used rather than the two nozzles. Twenty-five hours of circulation time was required by this method, and presumably the same or higher rate of power input was required. Thus, the superiority of a properly designed and placed nozzle over a conventional spider was demonstrated.

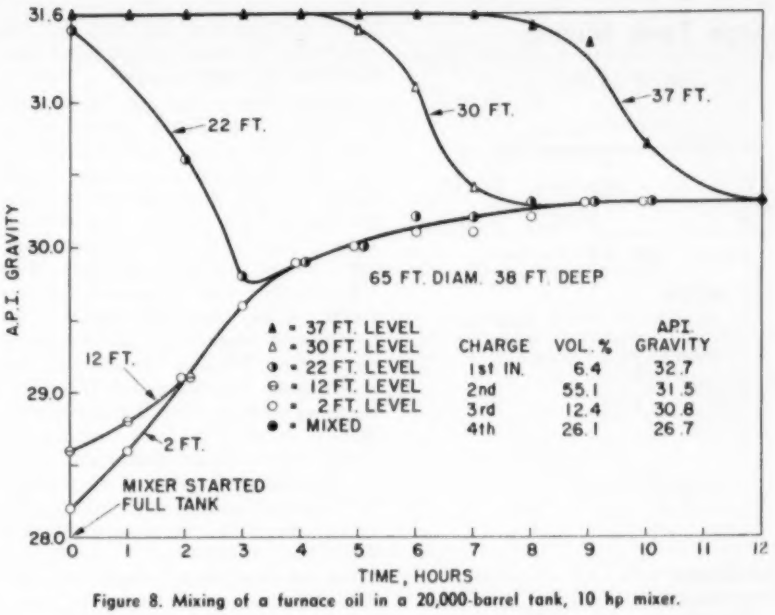

Figure 8. Mixing of a furnace oil in a 20,000-barrel tank, 10 hp mixer.

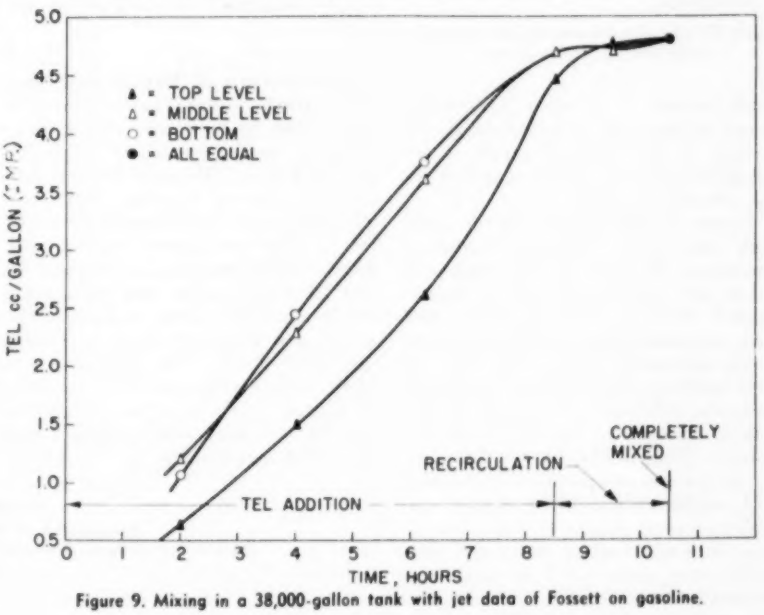

Figure 9. Mixing in a 38,000-gallon tank with jet data of Fossett on gasoline.

Mixing with Propeller Mixers—An 80,000-barrel gasoline storage and blending tank is shown in Figure 10 with a side-entering 28-inch diameter propeller mixer in the proper position. Runs were made in such a tank for the addition of TEL solution to gasoline both for a stratified start and for mixing during and after TEL addition. Figure 11 shows data for an operation wherein a concentrated TEL solution was added slowly for 3.5 hours at the bottom of the tank already filled with base stock. The final liquid depth was 39 feet, and the liquids were well stratified before mixing. The TEL concentration was 15.25 cc per gallon at the 2-foot level, 0.75 cc per gallon at the 20-foot level, and 0.2 cc per gallon at the 37-foot level. The tank contents were allowed to remain quiet for ½ hour as shown in the plot, and the analyses did not change. The mixer was started and samples taken each half hour. Considerable mixing is evident at the 20-foot level after one-half hour, and at the one hour sampling the entire tank contents are very nearly uniform. The tank was considered to be satisfactorily blended at the end of two hours of mixing.

The side-entering mixer had a 28-inch diameter square pitch propeller, rotating at 420 rpm. Its rated power was 25 hp, but it actually required only 20.3 hp to run in the gasoline. The two-hour mix was accomplished with a power input of 0.254 hp per

Large Tank Mixing . . .

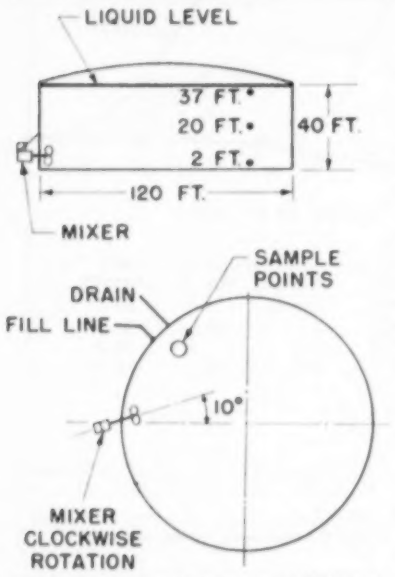

Figure 10. Location of mixer in 80,000-barrel tank showing sample points.

1000 barrels, or a total of 40.6 hp hours. In this type operation the entire mixing of the stratified layers is accomplished by the power supplied by the side-entering mixer.

Figure 12 shows data for the same tank but under different operating conditions. In this run the tank was filled with base stock and the mixer started. After 1½ hours operation, the TEL concentration was unchanged, and it was assumed that the tank contents were uniform. TEL solution was added as in the previous run through the fill line at the side of the tank near the bottom (Figure 10), but in this case the mixer was in operation during the TEL addition. The TEL solution was added over a period of four hours, and the concentrations at the different levels were determined at half hour intervals. After the TEL addition, the line was washed clean of TEL by fresh gasoline. This flow lasted for three-quarters of an hour. One hour after the addition of the wash gasoline, the analyses at the three levels were uniform and the tank was completely blended.

The energy required for mixing in this case was supplied both by the stream of TEL addition and wash, and by the mixer. The TEL addition and wash required 4.75 hours of filling pump operation at 0.1 hp, or a total of 0.5 hp hours at the open pipe. The mixer operated at 20.3 hp for a total of 5.75 hours of mixing amounting to 116.7 hp hours. The entire energy for mixing including the TEL fill and wash totals 117.2 hp hours. The mixer alone accomplished the final mix in one hour. The mixer power input was 0.254 hp per 1000 barrels.

Comparison of the runs of Figures 11 and 12 show almost identical total time for TEL addition and mixing; in the "stratified" case 5.5 hours (total minus the half hour interval between the end of TEL addition and start of mixer) and in the "on-the-run" case 5.75 hours. Actually however, less total energy was expended by the mixer for the "stratified" than for the "on-the-run" operation; 40.6-hp hours as against 116.7-hp hours for the mixer alone. The energy for TEL addition and washing is small and approximately equal for both operations. Thus, there is little if any difference in total time for addition and mixing by either method, but less total energy is required for mixing when the liquids are stratified at the start, provided the mixer is well positioned and has sufficient power input to cause rapid entrainment of all parts of the liquid.

Comparison of Mixers and Nozzles—The two 80,000-barrel runs with mixers can be compared with a recirculating nozzle jet-mixing from the data of Fossett.[2] He gives over-all data for one case of blending TEL with gasoline in an 80,000-barrel tank 118 feet in diameter; almost identical conditions as the two cases of Figures 11 and 12. Fossett states that by using a single nozzle 1.6 inches in diameter he achieved a complete blend in a total time of 9 hours. The operation was identical to that described for the data of Figure 9; the time for circulation and TEL addition was 5.5 hours, and for additional circulation, 3.5 hours. The total power of the jet at the nozzle can be calculated from the data and amounts to 15.6 hp. The total energy required by the recirculation-nozzle method is 15.6 x 9, or 140-hp hours. This compares with a total of 117.2-hp hours (including TEL addition) for a mixer "on-the-run" operation, and 41 hp hours for the "stratified" type operation.

Comparison of data on the performance of the three mixing techniques for the 80,000-barrel operations is shown in Table 1. Two bases are used. The first is on the power in the jet streams alone, whether from a nozzle, a pipe, or a propeller, or combinations thereof. The second takes into account the energy required to force the TEL solution into the tank through the feed line, and also the energy required to recirculate the tank contents through the nozzle. Since Fossett and Prosser do not give any data for the pipe line resistance, a typical[1] pipe line feed and withdrawal set-up was assumed as follows: The withdraw line, 12-inch pipe, the feed line 10-inch pipe, each line of length equal to 2100 feet of equivalent straight pipe. Recirculation was achieved by withdrawing through the 12-inch line to the pump and returning to the nozzle through the 10-inch line. TEL is inducted in the 10-inch line.

The first section of the table gives the time for each operation, and the total time. The total time to mix shows that the propeller mixer operated with stratified liquids requires the least total mixing time. The ratios of total time to mix show that the mixer used during filling required 2.87 times longer, and the recirculation-nozzle 4.5 times longer than when the mixer is

TABLE 1

Comparison of Mixing Techniques
80,000 Barrel Tank, Blending Tetraethyl Lead and Gasoline

	Circulation by an outside pump, injection thru a nozzle with TEL addition	SIDE-ENTERING PROPELLER	
		Mixing during TEL Addition	Mixing from Stratified start
Time for addition of TEL, hours	5.5	4.75	3.5
Mixing after TEL addition, hours	3.5	1.0	2.0
Total mixing time, hours	9.0	5.75	2.0
Ratio of total time to mix	4.5	2.87	1.0
Rate of liquid circulation, gal./min.			
Pump	600		
Mixer		16,000	16,000
For energy at nozzle or mixer only. Piping not considered			
Power at nozzle or mixer, HP	15.6	20.3	20.3
as axial flow, HP	15.6	3.3	3.3
as non-axial flow, HP	0	17.0	17.0
Total horsepower hours			
at nozzle or inlet pipe	140	0.5	0.4
at mixer	0	116.5	40.6
combined inlet and mixer	140	117	41
Ratio of horsepower hours required	3.42	2.85	1.0
For pumping thru 2100 ft. (equivalent) of 12 in. suction line and 2100 ft. of discharge line. Complete operation.			
Total horsepower hours at pump and mixer	485	216	114
Ratio of total horsepower hours required	4.3	1.9	1.0
Ratio of total time to mix	4.5	2.87	1.0

operated alone.

The next section shows the amount of liquid circulated in the jet streams. The pump circulates 600 gpm whereas the propeller recirculates 16,000 gpm. The large-volume relatively low-velocity flows are highly advantageous for efficient use of power for entrainment and mixing.[1]

Data are shown for the power in the streams, both as axial and as non-axial flow. All energy in the stream from the nozzle is in the axial direction and amounts to 15.6 hp. The propeller stream has a total power of 20.3 hp but only 3.3 are in the axial direction and 17.0 are in the non-axial flow. The non-axial energy is in rotational and turbulent components of flow. Probably, the superior mixing performance of the propeller is a function of this difference in energy distribution. The jet created by the propeller seems to distribute and mix the entrained liquids more effectively than a jet issuing from a pipe or nozzle.

The mixer alone uses the least amount of total energy. The ratio of horsepower hours shows that the mixer running during addition requires 2.85 times, and the recirculation-nozzle operation requires 3.42 times the energy used by the mixer operation alone. This operating advantage is based on the liquid jet alone and when the energy expended in the external piping system is accounted for, the operating advantage of the propeller mixer is even larger.

The last section of the Table shows comparisons of the total power including a recirculating line, but does not include the pump efficiency. The recirculating lines required for a pump-nozzle set-up (which is believed to be a conservative one) adds about 25 percent to the energy required over and above the power in the jet issuing from the nozzle. The ratios show that the side-entering propeller mixer is very much more efficient than the recirculation-nozzle method. The recirculation-nozzle method requires 4.3 times the energy of the mixer alone (and 4.5 times the time required), and 2.2 times the energy of the mixer operated during TEL addition.

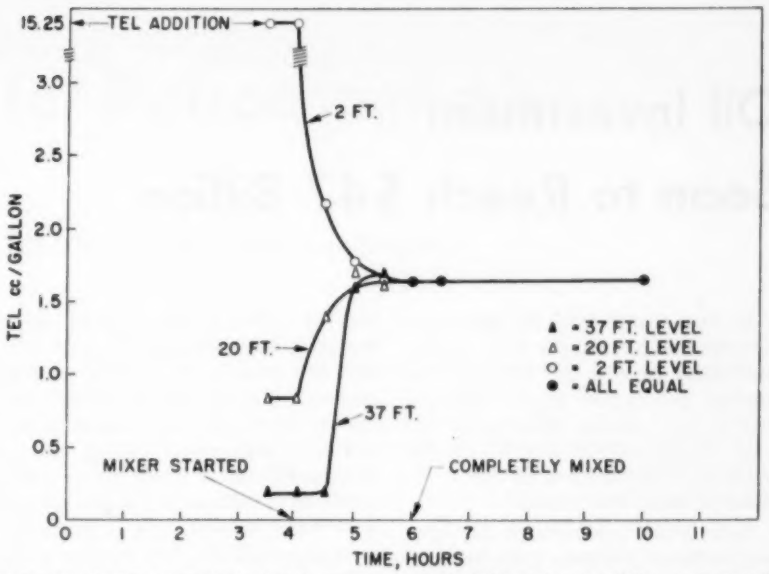

Figure 11. Mixing tetraethyl lead with gasoline in an 80,000-barrel tank, 25-hp mixer started with stratified liquids.

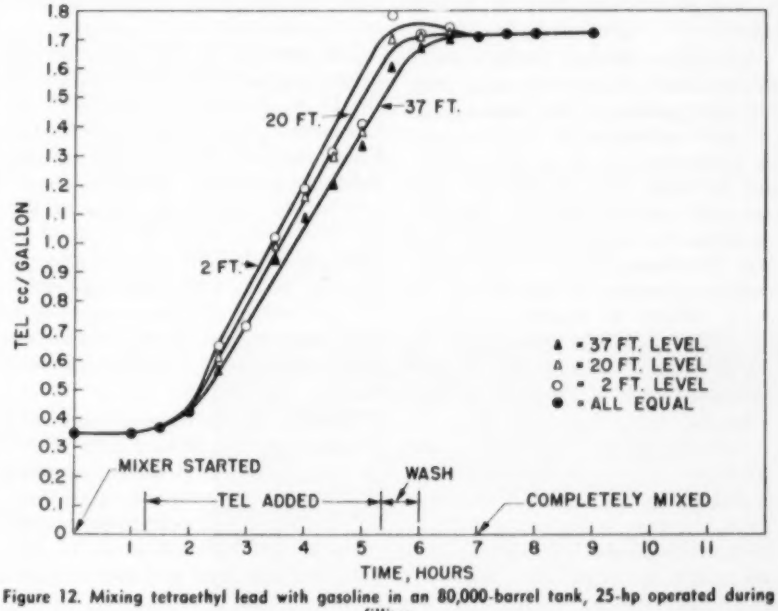

Figure 12. Mixing tetraethyl lead with gasoline in an 80,000-barrel tank, 25-hp operated during filling.

Conclusion—Blending of liquids in large tanks is accomplished by causing a stream of fluid to flow so that other fluid is entrained and mixed by turbulent exchange. The flow stream must have sufficient energy and momentum and a direction of flow such as to reach all parts of the liquid. Streams produced by propellers entrain and mix liquid as effectively, or more effectively, than pure axial-flow streams from nozzles. Further, all the energy delivered by a rotating side-entering mixing propeller is present in the flow stream, whereas it is necessary to use a large amount of energy to overcome pipe line resistance to produce recirculating-nozzle flow streams. As a result, the mixers can produce equivalent flow in tanks for less energy than can be done by an external recirculation pump. Finally, for a given distance in which entrainment and mixing is to take place, there is an optimum jet stream diameter,[1] and this diameter is relatively large. The jet-head-time relations developed by Fossett from the jet experiments also shows that "economy (is) to be derived by - - - - increasing flow at the expense of head,"[2] thus confirming the general conclusions of Folsum that small diameter jets are not efficient for entraining in large tanks. The large diameter turbulent jet streams formed by properly positioned side-entering mixing propellers, provide the best known method for producing efficient mixing in large diameter tanks.

LITERATURE CITED

[1] Folsum, R. G., and Ferguson, C. K., Trans. Am. Soc. Mech. Engrs., 71, 71 (1949).

[2] Fossett, H., and Prosser, L. E., J. Institution Mech. Engrs., 160, No. 2, 224, 240, 245 (1949).

[3] Fossett, H., Institution of Chem. Engrs., 29, 322 (1951).

[4] Rushton, J. H., and Oldshue, J. Y., Chem. Eng. Progress, 49, 161 (1953).

Oil Investment Soon to Reach $47 Billion

BY THE END of 1954 the petroleum industry will have in the U. S. a gross investment of over $47 billion. That amount will include the $4 billion of capital expenditures being made this year. At the middle of this year the industry's investment in the U. S. stood at about $45 billion.

Some years ago, through its vigorous postwar expansion, petroleum became the third largest industry of the U. S. in terms of investment or assets. It now is not far short of second place.

Agriculture employs an investment of over $165 billion—far more than any other industry. The public utilities were estimated in 1953 to have an investment of about $52 billion, and the total subsequently has been increased substantially, as extensive expansion has been under way in that field. Petroleum therefore has no immediate prospects of overtaking the public utilities in amount of investment. The railroads represent the fourth largest U. S. industry, with gross investment of about $34 billion.

At the end of this year the U. S. petroleum industry investment of over $47 billion will be nearly three times as great as at the end of World War II. In the nine postwar years, 1946-1954, expenditures for property, plant, and equipment in the U. S. will total about $29.5 billion. The industry investment at end of the war had been only around $17.7 billion.

The sharp increase in the industry's capital investment has reflected the vigorous postwar expansion of facilities in all divisions, but the gain has been accentuated by the inflated costs of all new facilities. The industry now has almost three times as much investment as at the end of the war, although it has perhaps only about twice as much in physical facilities, as postwar costs have been double those before the war.

Expenditures. The petroleum industry will make capital expenditures of over $4 billion in the U. S. in 1954, the API has estimated. This $4 billion will include $2.2 billion or 55.0 percent for production department facilities, $144 million or 3.6 percent for natural gasoline and cycling plants, $846 million or 21.1 percent for refineries; $315 million or 7.8 percent for pipe lines, tankers, and other transportation facilities, 370 million or 9.2 percent for marketing facilities, $66 million or 1.6 percent for fertilizer and chemical plants, and $67 million or 1.7 percent for other facilities.

The industry in 1953 made record capital expenditures of $4.6 billion in the U. S., according to Frederick G. Coqueron, petroleum analyst, the Chase National Bank, in the recently published pamphlet, "Financial Analysis of the Petroleum Industry for 1953." Of the $4.6 billion spent in 1953, $2,975,000,000 or 64.7 percent was for leases, wells, and equipment for producing oil and natural gas. New gasoline and cycling plants cost $125 million or 2.7 percent of total capital expenditures.

Outlays in the transportation department totaled $450 million or 9.8 percent of the total, including $325 million or 7.1 percent for pipe lines, $100 million or 2.2 percent for marine facilities, and $25 million or 0.5 percent for tank cars and motor transport.

Refineries and chemical plants cost $675 million or 14.7 percent of the total spent.

Estimated Assets Employed (or Investment) in U. S. Petroleum Industry, December 31, 1953

Source: Chase National Bank Bulletin, "Financial Analysis of the Petroleum Industry for 1953."

ITEM	Net Assets		Gross Assets	
	$ Million	% of Total	$ Million	% of Total
Current Assets...	9,000	33.8	9,000	20.8
Property, Plant, & Equipment..	17,050	64.0	33,600	77.8
Other Assets.....	600	2.2	600	1.4
Total.....	26,650	100.0	43,200	100.0

Marketing facilities required $325 million or 7.0 percent. Other facilities cost $50 million or 1.1 percent.

Investment. Gross investment in the U. S. petroleum industry at the end of 1953 was $43.2 billion, according to the Chase National Bank report. Of that amount, fixed assets, in the form of property, plant, and equipment, accounted for $33.6 billion or 77.8 percent. Current assets, including cash, oil inventories, materials, supplies, etc., represented $9 billion or 20.8 percent, and other assets constituted $600 million or 1.4 percent.

Of the $33.6 billion investment in property, plant, and equipment at the end of 1953, $18,625,000,000 or 55.5 percent was in facilities for production of crude oil and natural gas; $775 million or 2.3 percent in gasoline and cycling plants; $5,850,000,000 or 17.4 percent in refineries and chemical plants; $3.7 billion or 11.0 percent in marketing facilities; $550 million or 1.6 percent in miscellaneous facilities; and $4.1 billion or 12.2 percent in transportation properties, including $2.7 billion or 8.0 percent in pipe lines, $1,050,000,000 or 3.1 percent in marine facilities, and $350 million or 1.1 percent in tank cars and motor transport.

Estimated Oil Industry Capital Expenditures in U. S. in 1954

Source: American Petroleum Institute.

Department	Thousand Dollars	Percent of Total
Production, Total	**2,206,192**	**55.0**
Crude Oil, Total	2,027,730	50.5
Leases	369,146	9.2
*Wells, Equipment	1,658,584	41.3
Natural Gas, Total	75,819	1.9
Leases	13,741	0.3
*Wells, Equipment	62,078	1.6
Other	102,643	2.6
Natural Gasoline and Cycling Plants	**143,682**	**3.6**
Transportation, Total	**314,566**	**7.8**
Pipe Lines, Total	200,136	5.0
Crude Oil Lines	87,286	2.2
Product Lines	95,427	2.4
Natural Gas Lines	17,423	0.4
Marine, Total	83,940	2.1
Tankers	68,186	1.7
Barges	14,331	0.4
Other	1,423	0.0
Tank Cars	19,259	0.5
Motor Transport	8,648	0.2
All Other	2,583	0.0
Refining	**845,994**	**21.1**
Fertilizer and Chemical Plants	**66,531**	**1.6**
Marketing	**370,366**	**9.2**
Other	**66,868**	**1.7**
Total	**4,014,199**	**100.0**

* Includes expenditures for intangible development cost of producing wells and dry holes whether capitalized or charged to earnings.

Thermo Data for Petrochemicals

Part XX. Ketene-Acetone Equilibrium.

Kenneth A. Kobe and Roland H. Harrison
University of Texas, Austin

HEAT CAPACITY and enthalpy values for acetone[5] and ketene[6] were given in previous papers in this series. The thermodynamic data given in Table 1 for acetone were calculated from spectroscopic data by Godnev, Pajuchina and Swerdlin.[3] The heat capacity values given here are not exactly the same as those found in the earlier paper because the calculated values of Table 1 were smoothed to give the more consistent set of data used in the previous paper.

No calorimetric data are available for ketene. The thermodynamic data given in Table 2 were recalculated using the spectral data of Drayton and Thompson.[2] Although Drayton and Thompson calculated the functions from 250 to 900 K., several inaccuracies were found and the calculations were repeated. Again the heat capacities given here do not agree exactly with the previous paper because of the different sources of the spectral data and the smoothing process used.

Acetone-Ketene Equilibrium—The equilibrium constant for the reaction (Equation 1) was calculated from the free energy data of Tables 1 and 2, as shown in previous papers.[1,4] The heats of formation are those given in Table 3 and data for methane are from a National Bureau of Standards compilation.[8]

$$\underset{\text{Acetone}}{CH_3COCH_3} \rightarrow \underset{\text{Ketene}}{H_2C=C=O} + \underset{\text{Methane}}{CH_4} \qquad (1)$$

The equilibrium constant can be expressed as a function of the activity of each component, or the mole fraction, fugacity coefficient and total pressure, as given in Equation (2).

$$K = \frac{(x)\,(x)}{(1-x)} K_\nu \left[\frac{\pi}{1+x}\right] = \frac{x^2}{1-x^2} K_\nu \pi \qquad (2)$$

TABLE 1
Thermodynamic Functions for Acetone

T°K.	$\frac{G°-H°_0}{T}$	$\frac{H°-H°_0}{T}$	S°	$C°_p$
298.1	57.53	13.19	70.72	18.38
300	57.62	13.21	70.83	18.47
400	61.67	15.00	76.67	22.69
500	65.20	16.99	82.19	26.56
600	68.55	18.77	87.32	29.93
700	71.53	20.60	92.13	32.79
800	74.40	22.09	96.49	35.27
900	77.23	23.97	101.20	37.44
1000	79.72	25.31	105.03	39.04
1100	82.18	26.63	108.81	40.81
1200	84.61	27.90	112.51	42.29
1300	86.84	28.99	115.83	43.60
1400	88.93	30.17	119.10	44.44
1500	91.10	31.12	122.22	45.35

Mr. Harrison is a Jefferson Chemical Company Fellow in chemical engineering.

The preceding 19 parts of this series were titled *"Thermochemistry for the Petrochemical Industry."* The title of the series has been changed since the series now includes thermodynamic as well as thermochemical data.

The authors have asked what petrochemicals you, the reader, would like to have covered in future articles. We are passing along to you the opportunity to answer this question. Please address all suggestions of this nature to Petrochemicals Editor, Petroleum REFINER, P. O. Box 2608, Houston 1, Texas.

(Approximately 80 copies of the collected reprint of Parts I—XIX are available at $1 per copy, postpaid.)

x = mole fraction of acetone reacted
K_ν = function of fugacity coefficients
π = total pressure

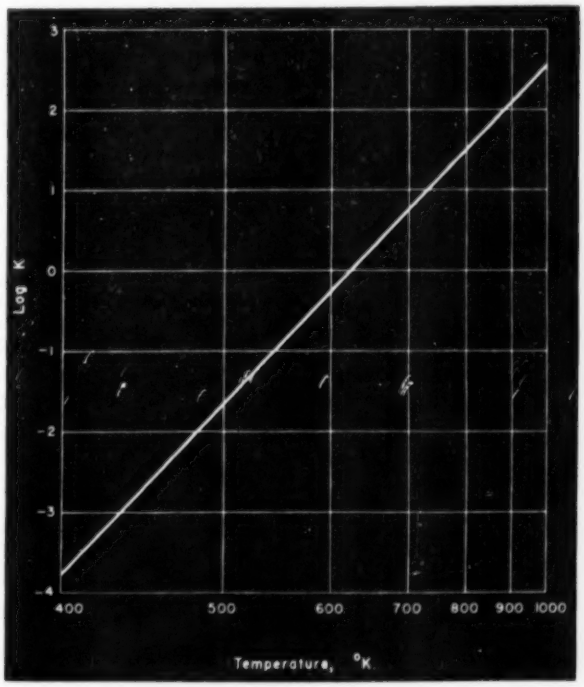

Figure 1. The equilibrium constant as a function of temperature.

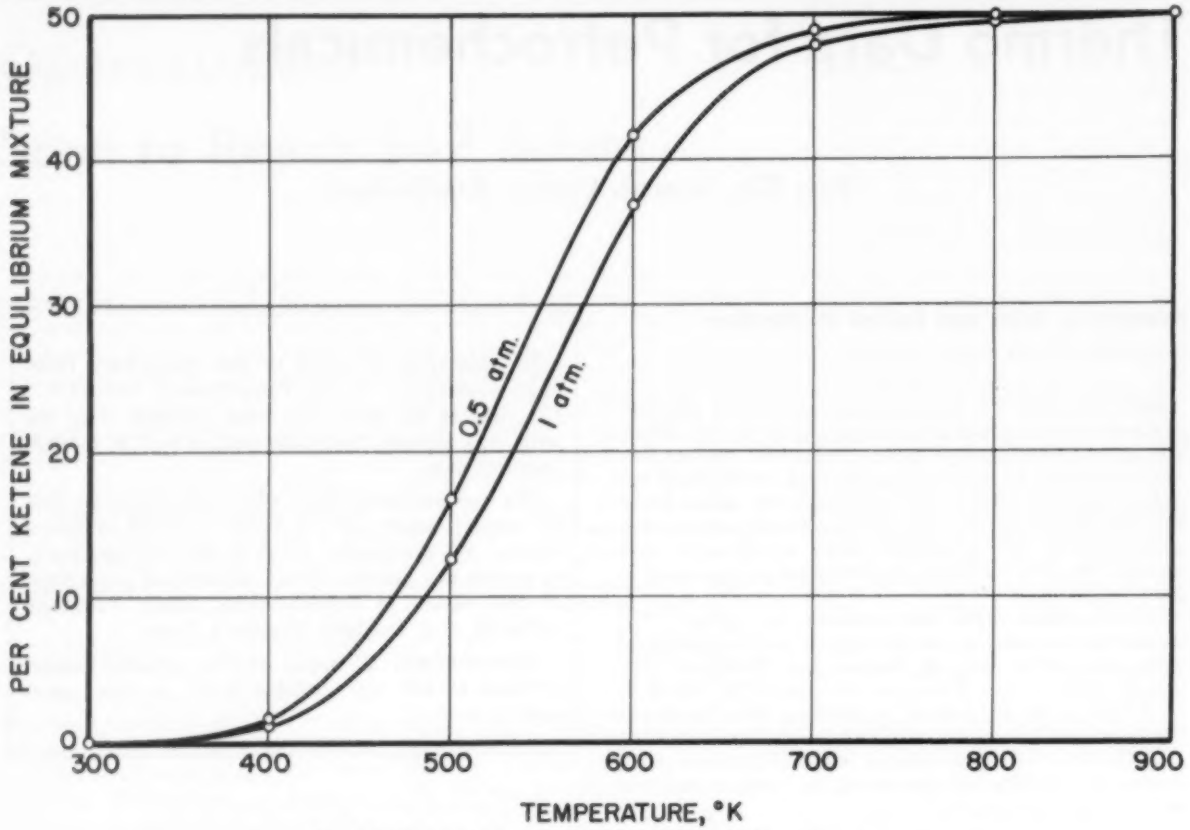

Figure 2. Degree of conversion at 0.5 and 1.0 atmospheres pressure.

As the ketene from acetone process operates at substantially atmospheric pressure and relatively high temperatures, the gases may be assumed to behave ideally, hence K_P was assumed to be unity in all calculations.

The equilibrium constants for reaction 1 and degree of conversion (x) are given in Table 4. The equilibrium constant is shown as a function of temperature in Figure 1, and the degree of conversion at a total pressure of 1.0 and 0.5 atmospheres is shown in Figure 2.

TABLE 2

Thermodynamic Functions for Ketene

T°K.	$\frac{G°-H°_0}{T}$	$\frac{H°-H°_0}{T}$	S°	$C°_p$
250	45.55	8.580	54.13	10.36
273.16	47.31	8.753	56.06	10.86
291.16	47.87	8.895	56.77	11.24
298.16	48.09	8.953	57.04	11.39
300	48.14	8.968	57.11	11.43
400	50.84	9.833	60.67	13.40
500	53.13	10.72	63.84	15.04
600	55.16	11.55	66.71	16.38
700	57.00	12.33	69.32	17.52
800	58.69	13.04	71.72	18.48
900	60.26	13.69	73.95	19.31
1000	61.74	14.29	76.02	20.04
1100	63.12	14.84	77.96	20.66
1200	64.44	15.35	79.79	21.21
1300	65.68	15.82	81.50	21.68
1400	66.87	16.25	83.12	22.10
1500	68.01	16.65	84.66	22.46

TABLE 3

Heats of Formation of Acetone, Ketene and Methane

COMPOUND	$(\Delta H°_f)_{25\ C.}$	$(\Delta H°_f)_0$ K.	Reference
Acetone	—51,790	—47,860	7
Ketene	—14,600	—13,710	8
Methane	—17,889	—15,987	8

LITERATURE CITED

[1] Arnold, C. W., and Kobe, K. A., Chem. Eng. Progress, **48**, 293-6 (1952).

[2] Drayton, G. J., and Thompson, H. W., J. Chem. Soc., **1948**, 1416.

[3] Godnev, I., Pajuchina, A., and Swerdlin, A., J. Phys. Chem. (USSR), **14**, 374 (1940).

[4] Harrison, R. H., and Kobe, K. A., Chem. Eng. Progress, **49**, 349-53 (1953).

[5] Kobe, K. A., Harrison, R. H., and Pennington, R. E., Petroleum Refiner, **30**, No. 8, 119-22 (1951).

[6] Kobe, K. A., and Pennington, R. E., Petroleum Refiner, **29**, No. 9, 135-9 (1950).

[7] Miles, C. B., and Hunt, H., J. Phys. Chem., **45**, 346 (1941).

[8] Rossini, F. D., et al., National Bureau of Standards Circ. 500 (1952).

TABLE 4

Equilibrium Constant and Conversion for the Reaction

$$CH_3COCH_3 \rightleftarrows H_2C=C=O + CH_4$$

T°K.	$\frac{\Delta G°}{T}$	Log K	K	Degree of Conversion, x	
				x = 1	x = 0.5
300	—33.52	—7.3257	4.724×10^{-8}	0.000	0.000
400	—17.38	—3.7983	1.591×10^{-4}	0.013	0.018
500	— 7.65	—1.6719	2.129×10^{-2}	0.144	0.202
600	— 1.28	—0.2797	5.252×10^{-1}	0.587	0.716
700	3.38	0.7387	5.479	0.920	0.957
800	6.79	1.4839	3.047×10^{1}	0.984	0.992
900	9.32	2.0369	1.089×10^{2}	0.995	0.998
1000	11.50	2.5133	3.261×10^{2}	1.000	1.000
1100	13.21	2.8870	7.709×10^{2}	....	....
1200	14.55	3.1798	1.513×10^{3}	....	....
1300	15.76	3.4443	2.782×10^{3}	....	....
1400	16.84	3.6803	4.790×10^{3}	....	....
1500	17.64	3.8552	7.165×10^{3}	....	....

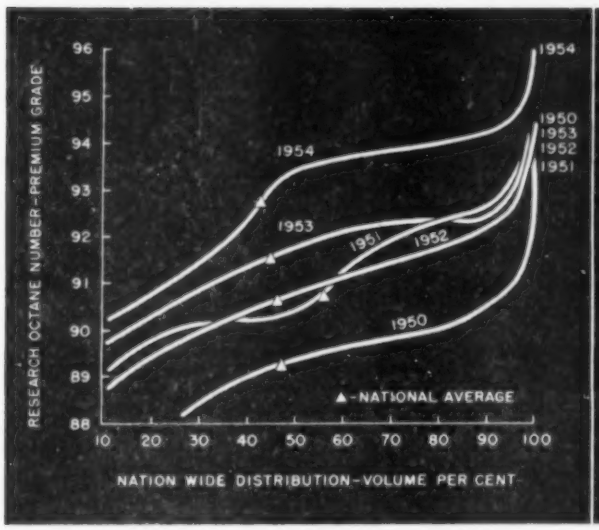

Figure 1

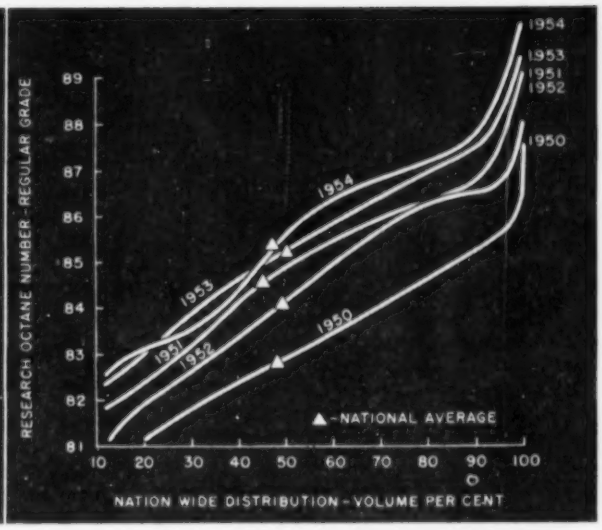

Figure 2

Research octane number and distribution of (Figure 1) premium grade and (Figure 2) regular grade gasoline, nationwide, January of year noted.

What Is the Octane Picture?

Part I. Trends and Forecasts

Part II. Road Rating Effects

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IN ALL THE RECENT discussion about gasoline quality and automobile engine design trends, there has not been published any direct comparisons of these trends in relation to each other. This Part I estimates future gasoline qualities based upon an interpretation of available data and compares such estimates with estimated concurrent passenger car requirements. Part II will demonstrate general correlations of the effect on road ratings of certain refinery controllable gasoline quality factors, and outline laboratory and road testing programs to develop specific correlations whereby optimum usage of gasoline octane numbers in a given refinery may be assured.

What the Future Holds—That octane numbers of motor gasolines are on the way up is not news. A spokesman[1] for one major oil company recently forecast the possibility of 99.7 Research octane number premium and 93.7 octane regular gasolines by 1961. The spokesman[2] for another major oil company forecasts the possibility of as high as 98.0 octane pool gasoline in the foreseeable future. If it were intended only to prove the point of a continuing octane increase, reference could be made to copies of these papers and this part of the discussion would be concluded. It is believed, however, that it will be of considerable interest to establish the rate at which this increase appears to be taking place.

An extrapolation from the past is usually the best available indication of the future. In attempting to look at the rate of octane increase on this basis, it was quite obvious that the rate of change was anything but consistent in the period from January, 1950, to January, 1954. Four things occurred in 1953 which tended to alter the picture considerably. The Korean War ended. Catalytic reforming began to boom. The consuming public was introduced to alphabet gasoline. A definite change in the rate of progress of our economy began to be felt. This last, a levelling off or slowing down of the general consumer demand curve, combined with a continuing increase in refining capacity, has resulted in the most competitive gasoline market condition of the past decade. This market condition is concurrent with stiffening competition within the automotive industry. The combination of more efficient, higher compression ratio automobile engines and better quality gasolines to take fuller advantage of these mechanical improvements, poses questions about the immediate future not readily answerable in terms of the past.

Nevertheless, to get a starting point and a trend indication leading to already forecast octane levels, an analysis of gasoline quality over the past four years was made. Figure 1 shows the nationwide volumetric distribution of premium grade gasoline in relation to Research octane levels as of January for 1950 through 1954. Each point on a curve shows the volume percent of gasoline having a Research octane number at or below the level indicated. The abnormal conditions of 1951, 1952 and 1953 are apparent from the relative positions of the distribution curves. The national average points are arithmetical averages of the 10, 30, 50, 70, and 90 percent octane levels.

Figure 2, similar curves for regular grade gasolines, demonstrates an even more confused picture. Where the average premium grade gasoline increased 1.2 octane numbers in 1953, regular grade went up less than one-half of an octane number in the same year.

From these data, the help of a dependable crystal ball, a little bit of clairvoyance, and considerable study of available information, these same type of distributional curves have been estimated for gasolines through January, 1958.

Figure 3 shows the estimated nation-

The Octane Picture . . .

wide distribution of premium grade gasolines in relation to octane level for January, 1955, 1956, 1957, and 1958. These same type distributional curves for regular grade gasoline are shown in Figure 4. It will be seen that these extrapolations assume a more or less steadily increasing octane level. Suffice it to say that the view into the future was so hazy that only the general contour was discernable. The small hills and vales were lost in the mist.

Comparison of these forecast octane levels with estimated engine requirement can now be made. Figure 5 shows the estimated Research octane number required to satisfy—keep free of objectionable knock—various percentages of all passenger cars on the road in 1955 and 1958.

These curves were arrived at by extending the average relationship between compression ratios and octane requirements of today's cars to the higher compression ratios estimated for the next four years. Small compensations were made for expected mechanical octane improvements by the automobile manufacturers, as well as the production, by refiners, of lubricating oils tending to reduce harmful engine deposits.

These estimated requirements are based upon suppression of knock only. It has been assumed that preignition difficulties will be eliminated in some way not appreciably affecting knock-suppression octane requirements.

Taking into consideration the percentage of gasoline consumed by all trucks and miscellaneous uses, and assuming this to be essentially all regular grade, about forty percent of all passenger cars use premium grade fuel. It seems reasonable to assume then that these cars are for the most part those having the highest octane gasoline requirement. Based on this assumption, comparisons of car requirement and available premium grade gasolines for January, 1955 and 1958, are shown in Figure 6.

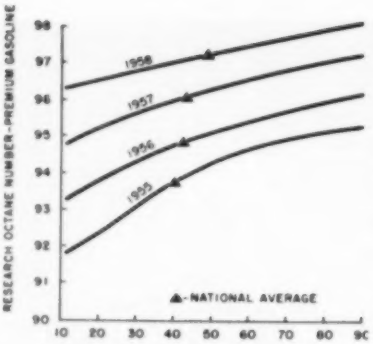


Figure 3. Research octane number and premium grade gasoline distribution (nationwide, January of year noted).

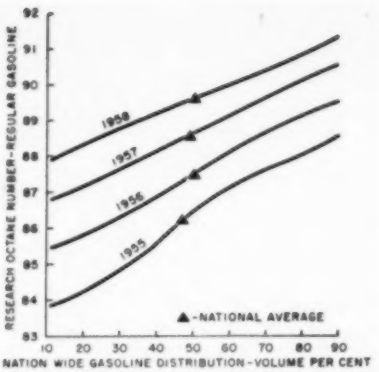


Figure 4. Research octane number and regular grade gasoline distribution (nationwide, January of year noted).

On the basis of these forecasts, the average premium gasoline will keep knock free approximately 95 percent of the highest requirement cars on the road in 1958. In Figure 7, a comparison of regular grade gasoline quality with engine requirements of the remaining sixty percent of all passenger cars is shown. This indicates that essentially all the lowest requirement cars would be satisfied with the forecast average regular grade quality available in 1958.

Variations in requirements within a given car make, will cause many automobiles, which will use regular grade gasoline, to have requirements above the maximum shown. However, it is believed that our forecast is not sufficiently accurate to properly define the upper end of these requirement curves. Similarly some of the cars using premium gasoline will have requirements much below the average premium octane level. These, however, will not appreciably affect the upper end of the premium car satisfaction curves.

Comparison of the car requirement and fuel quality estimates, without regard to which cars are operated on which grade, indicates that the average regular grade gasoline will be capable of satisfying approximately 55 percent of all postwar cars in 1955 and approximately 65 percent in 1958. A similar comparison indicates that average premium gasoline will be capable of satisfying 97 percent of all postwar cars in 1955 and 99 percent in 1958. Thus a larger percentage of these total postwar cars should operate knock free with average gasoline in 1958 than in 1955.

A comparison of all 1954 model requirements only with January, 1955, gasolines, and forecasts 1957 models with January, 1958, gasolines, indicates a much lower percentage of satisfaction with regular grade gasolines. This was estimated to be only about 30 percent in both instances.

So much for future gasoline octane levels and car requirements. Part II, which has to do with the effect of certain controllable variables on gasoline quality, correlation of these variables with quality, and how one might establish his own correlations and use these to improve the quality of his products, will appear in an early issue.

Original presentation was before the regional meeting, Western Petroleum Refiners Association, Wichita, Kans., May, 1954.

REFERENCES

[1] Murphree, E. O., et al., "The Trend to High Octane Gasoline Is Sound," Metropolitan Section, SAE, October, 1953.

[2] Holaday, W. M., "What Can We Get from Higher Octane Number Fuels," SAE Annual Meeting, Detroit, January, 1954.

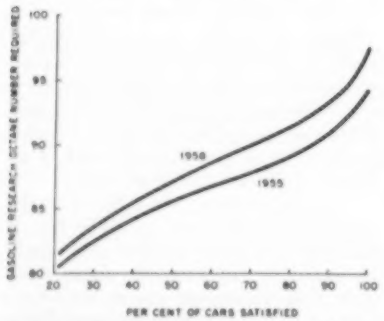


Figure 5. Estimated octane requirements of postwar passenger cars on the road (January of year noted).

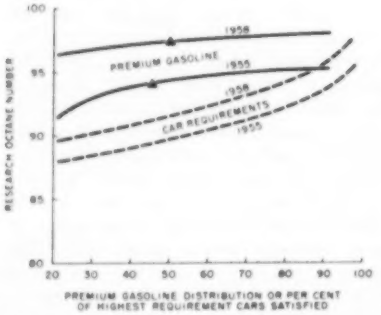


Figure 6. Premium grade gasoline distribution and requirements of highest 40 percent of cars. (January of year noted.)

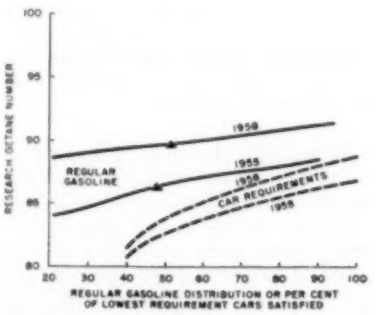


Figure 7. Regular grade gasoline distribution and requirements of lowest 60 percent of cars. (January of year noted.)

Understanding the chemistry of . . .

Petrochemical Reactions

Part 14. Alkylation Reactions

Part 15. The Oxo Reaction—Primary Alcohols from Olefins

Part 16. The Production and Reactions of Butadiene

Lewis F. Hatch,
University of Texas,
Austin

MANY OF THE reactions of olefins seem to be highly unlikely prospects for commercial utilization, but the petroleum industry well knows that what seems fantastic one day is commonplace the next. Thus it was with the Oxo reaction. The Oxo reaction consists of the treatment of an olefin with carbon monoxide and hydrogen in the presence of a cobalt catalyst to produce aldehydes.

$$CH_2CH=CH_2 + CO + H_2 \rightarrow \underset{n\text{-Butyraldehyde}}{CH_3CH_2CH_2C(=O)-H} + \underset{\text{Isobutyraldehyde}}{CH_3-CH(CH_3)-C(=O)-H}$$

The net result of the Oxo reaction is the addition of formaldehyde ($H-C(=O)-H$) across a carbon-carbon double bond.

Because of this, the reaction has been called *formylation* and *hydroformylation;* however, the term Oxo will be used here because of its general acceptance by the industry.

In most cases, the aldehydes are hydrogenated to give the more valuable primary alcohols.

$$CH_3CH_2CH_2C(=O)-H + H_2 \rightarrow \underset{n\text{-Butyl alcohol}}{CH_3CH_2CH_2CH_2OH}$$

$$CH_3-CH(CH_3)-C(=O)-H + H_2 \rightarrow \underset{\text{Isobutyl alcohol}}{CH_2(CH_3)-CH-CH_2OH}$$

The Oxo reaction is relatively new to this country, with the first plant (Esso Standard Oil Company) going on stream in Baton Rouge in 1949. Since that time at least five other companies have gone into production or seriously considering entering the field. The process originated in Germany as an outgrowth or extension of studies in the Fischer-Tropsch synthesis for the production of liquid fuels and oxygenated compounds from carbon monoxide and hydrogen.

The raw material requirements of olefins, carbon moxoxide and hydrogen are easily met by the petroleum industry. The carbon monoxide and hydrogen *(synthesis gas)* may be obtained from methane by partial oxidation, or by the reaction of methane with carbon dioxide, with carbon dioxide and steam or with steam alone.

$$2CH_4 + O_2 \rightarrow 2CO + 4H_2$$
$$CH_4 + CO_2 \rightarrow 2CO + 2H_2$$
$$3CH_4 + CO_2 + 2H_2O \rightarrow 4CO + 8H_2$$
$$CH_4 + H_2O \rightarrow CO + 3H_2$$

Which process is used will be determined by many factors, not the least being the ratio of carbon monoxide to hydrogen. If the original aldehydes are to be hydrogenated, then a source of carbon monoxide and hydrogen would

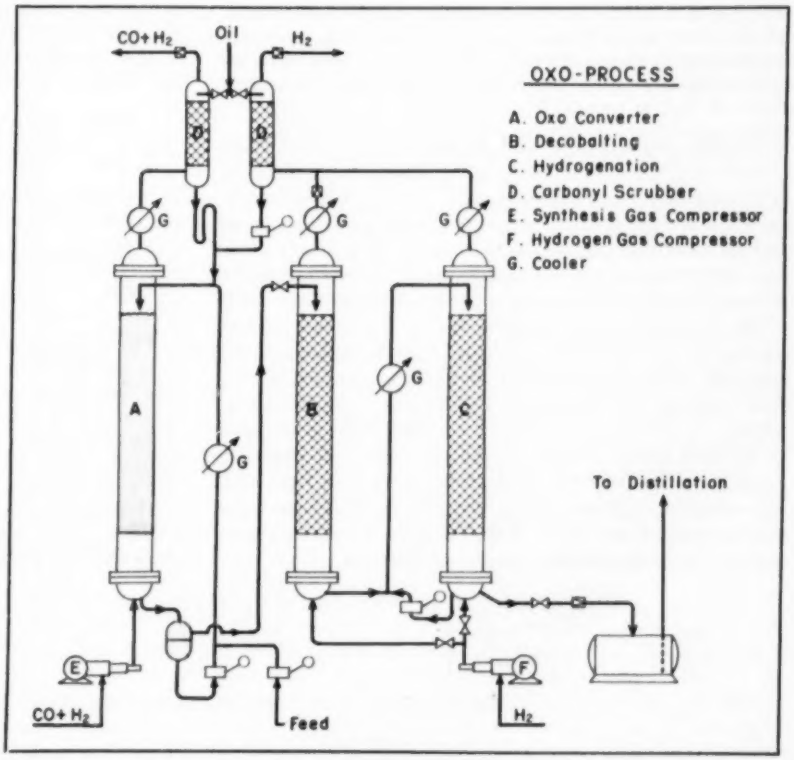
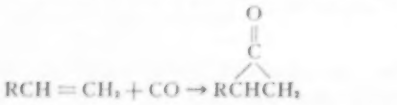


Figure 1. A simplified flow diagram of one version of the Oxo process. (Courtesy of Blaw-Knox Company).

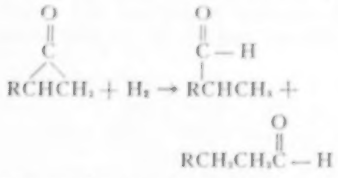
be used which would give an excess of hydrogen over the 1 to 1 ratio required for the Oxo reaction.

Many different olefins and substituted olefins have been tested and all have reacted with the exception of those with aromatic carbon-carbon double bonds. The catalyst used is cobalt which under the conditions of the reaction yields dicobalt octacarbonyl, $[Co(CO)_4]_2$, and cobalt hydrocarbonyl, $HCo(CO)_4$. Iron carbonyl, $Fe(CO)_5$, also has catalytic activity, but it is not used.

Reaction Mechanisms—Two different reaction mechanisms have been proposed to explain the Oxo reaction. The *cyclopropanone mechanism* postulates the formation of a cyclic intermediate with a cyclopropanone structure.



The three carbon ring is then opened by the hydrogen.

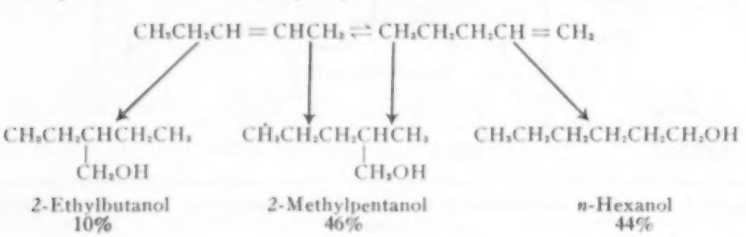


This mechanism is not highly regarded at the present time.

A *carbonium-ion mechanism* has been proposed, but this should come as no surprise for there are very few reactions for which a carbonium-ion mechanism has not been proposed. There is only a small amount of evidence that this type of mechanism is involved in the Oxo reaction, and most of this evidence is based on analogy to other similar reactions of carbon monoxide.

Factors Influencing the Reaction—The Oxo reaction leads to a complex mixture of aldehydes and alcohols and a number of by-products. The principal by-products are aldol condensation products and esters, acetals, ketones and polymerization products. The yields of primary alcohols, after hydrogenation, can, however, be as high as 90 percent provided the proper operating conditions are used.

The *structure of the olefin* is less of a factor in determining the nature of the reaction products than might be expected. With *straight-chain olefins*, the products of the Oxo reaction are essentially the same, regardless of whether or not the carbon-carbon double bond is terminal or in some other position in the molecule. For example, 2-pentene gives the same product distribution as 1-pentene. The simplest explanation for this fact is to assume a rearrangement of the olefin. The following equations represent the products formed after hydrogenation.

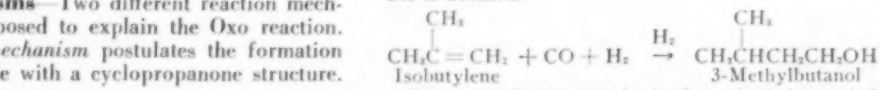


2-Ethylbutanol 10% | 2-Methylpentanol 46% | *n*-Hexanol 44%

There is obtained about 40 to 60 percent normal alcohol and 60 to 40 percent *a*-branched alcohol regardless of what straight-chain olefin is used. This generalization presents an interesting problem, for olefins with internal double bonds are thermodynamically more stable than those with terminal double bonds. The rearrangement and the Oxo reaction proceed simultaneously, with the Oxo reaction being the more rapid.

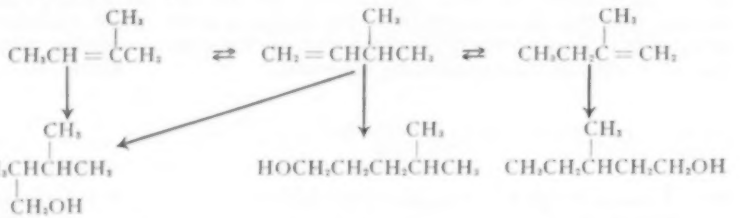
Branched-chain olefins with the following structure

always add a hydrogen atom to the carbon atom containing no hydrogen atoms; thus only one product is formed.



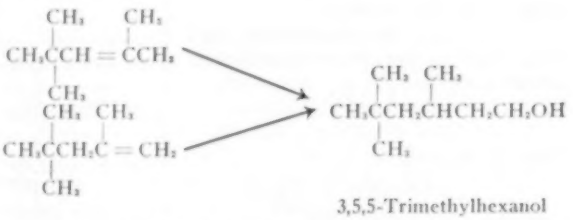
Isobutylene | 3-Methylbutanol

When the double bond of a branched-chain olefin is not in a terminal position, the products of the Oxo reaction are essentially the same as those obtained when the double bond is terminal. For example, 2-methyl-2-butene, 3-methyl-1-butene and 2-methyl-1-butene all give the same products.



2,3-Dimethylbutanol 5% | 4-Methylpentanol 55% | 3-Methylpentanol 45%

Commercial diisobutylene is a mixture of 2,4,4-trimethyl-2-pentene and 2,4,4-trimethyl-1-pentene. Because of the branched-chain nature of the 2-pentene it isomerizes to the 1-pentene and only one product is obtained from the mixture.



3,5,5-Trimethylhexanol

The structure of the olefin appears to have little influence on the heat of reaction (*ca.* 28,000 cal. per mole). The magnitude of this heat of reaction requires special consideration in the design of the reactor.

In general, low molecular weight olefins react at a lower temperature and more rapidly than do the higher molecular weight olefins.

Hydrogenation of the carbon-carbon double bond of the olefin is not a serious factor with the simple olefins; but diolefins and furans react by both hydrogenation and the Oxo reaction, while thiophene and phenanthrene react exclusively by hydrogenation. Benzene is inert toward both reactions.

The *catalyst* used for the Oxo reaction is dicobalt octacarbonyl, and the stability of this compound governs both the temperature and the pressure of the reaction. For Oxo reactions above 150 C and 3000 psi

almost any salt of cobalt may be used as the catalyst (from which the dicobalt octacarbonyl is derived), but for milder conditions it is necessary to use preformed dicobalt octacarbonyl or reactive cobalt metal (Raney cobalt).

A *temperature* of between 110 and 140 C. is used where a maximum yield of aldehyde is desired. A temperature range of 150-160 C. may also be used, but in this range a portion of the aldehyde is hydrogenated to the corresponding alcohol. Alcohols can be produced in one step by operating in the temperature range of 180-200 C. The temperature used is dependent upon the nature of the products desired, the nature and activity of the catalyst, and the ease with which it is converted to dicobalt octacarbonyl (the active catalyst) and on the nature of the olefin feed. It is thought that the isomerization reaction is more temperature dependent than the Oxo reaction; thus an increase in temperature will increase the rate of isomerization more than it will increase the rate of the Oxo reaction.

Pressures from 1500 to 10,000 psi of synthesis gas have been used, and the rate of reaction is independent of the synthesis gas pressure within the usual operating pressures (about 3000 psi). The minimum pressure is governed by the partial pressure of carbon monoxide required to prevent the decomposition of the dicobalt octacarbonyl. This pressure is about 600 psi at 150 C.

By-products are not a serious problem when operating conditions are adjusted to give the maximum yields of aldehyde. Usually about 10 to 20 percent of the product boils higher than the desired aldehyde or alcohol. These compounds are probably cyclic trimers of the aldehydes, and some decompose on hydrogenation to give the alcohol corresponding to the parent aldehyde. Aldol condensation of the aldehyde also probably accounts for some of the higher boiling material. Acetals and esters are secondary by-products. Ketone formation resulting from two molecules of olefin reacting with the potential formaldehyde is not of importance except with ethylene.

$$2CH_2=CH_2 + CO + H_2 \rightarrow CH_3CH_2\overset{\overset{O}{\|}}{C}CH_2CH_3$$

Diethyl ketone

Industrial Production—The industrial utilization of the Oxo reaction in this country is confined to propylene, the heptenes and diisobutylene. With propylene, both of the aldehydes (butyraldehyde and isobutyraldehyde) are separated and utilized as such. The aldehydes initially formed with the other olefins are hydrogenated in a second step to produce the more stable and more economically desirable alcohols (iso-octyl and nonyl alcohols).

The Oxo process is usually carried out in two separate chemical steps. The first step is the Oxo reaction, and the second step is a more or less conventional hydrogenation process using either the Oxo catalyst or a regular hydrogenation catalyst after removal of the Oxo catalyst. The Oxo reaction may utilize either a slurry-type process or a fixed-bed process.

The *slurry-type process* consists of a slurry of olefin or olefin-paraffin mixture and catalyst (3-5 percent) which is heated to 150 C. and fed to the bottom of the primary reactor at a pressure of about 3000 psi. Synthesis gas with a carbon monoxide to hydrogen ratio of 1 to 1 is added concurrently with the slurry. About two-thirds of this gas is recycle. The conversion in the primary reactor is about 70 percent, and cooling is required because of the exothermal nature of the reaction. The reaction is completed in a second reactor which may be operated at a 10 to 20 C. higher temperature. The overall reaction time is between 20 and 30 minutes. The recovery systems are conventional.

The use of a *fixed-bed process* has several advantages, such as elimination of the catalyst filtration step before hydrogenation and the necessity of handling solids. The heat of reaction, however, presents a problem which is only partially overcome by using a considerable excess of synthesis gas. A complete conversion of the olefin is also assured by this excess of synthesis gas. Deterioration of the catalyst in the fixed-bed process is caused by the solubility of the dicobalt octacarbonyl and its volatility. This can be offset by adding cobalt to the feed in the form of a fatty acid salt.

The Products—The Texas Eastman Company is producing both *n-butyraldehyde* and *isobutyraldehyde* from propylene. The n-butyraldehye is oxidized to butyric acid for use in the manufacture of cellulose acetate butyrate plastics. Two molecules of the aldehyde may be condensed to the eight carbon aldehyde which is dehydrated and hydrogenated to 2-ethylhexanol.

$$CH_3CH_2CH_2\overset{\overset{O}{\|}}{C}-H + CH_3CH_2CH_2\overset{\overset{O}{\|}}{C}-H \rightarrow CH_3CH_2CH_2\underset{\underset{CH_2CH_3}{|}}{\overset{\overset{OH}{|}}{C}}H\overset{\overset{O}{\|}}{C}-H$$

$$CH_3CH_2CH_2\underset{\underset{CH_2CH_3}{|}}{\overset{\overset{OH}{|}}{C}}H\overset{\overset{O}{\|}}{C}-H \xrightarrow[H_2]{-H_2O} CH_3CH_2CH_2CH_2\underset{\underset{CH_2CH_3}{|}}{C}HCH_2OH$$

2-Ethylhexanol

Carbide and Carbon Chemical Company may also use this process.

Hydrogenation without dehydration gives 2-ethyl-1,3-hexandiol, a mosquito repellent.

The aldehyde also forms polyvinyl butyral *(PVB)* with polyvinyl alcohol. This plastic is used as the interlayer of safety glass and as a coating for fabrics. Rubber accelerators are formed when it condenses with aniline or various other amines.

Both aldehydes are hydrogenated to the corresponding alcohols. Isobutyl alcohol is said to be equal to *n*-butyl alcohol in lacquer formulations.

The *octyl* and *nonyl* alcohols are the most important compounds synthesized by the Oxo process. These high molecular weight alcohols are used as solvents in lacquer formulations, anti-foam and froth flotation agents, etc., but their most important use is in the form of phthalic acid and phosphorus oxychloride esters to be used as plasticizers. These plasticizers are especially useful with vinyl chloride and vinyl chloride-vinyl acetate plastics. They are said to be better than the esters of 2-ethylhexanol—also a product of the Oxo reaction.

The following companies are now or have been active in the field: Carbide and Carbon Chemicals Company, E. I. du Pont de Nemours & Company, Enjay Company, Inc., Gulf Oil Company, Indoil Chemical Company, and Shell Chemical Corporation. Oronite Chemical Company and The Texas Company have also been active in research in this area.

The Future—The future of the Oxo process lies in its ability to produce many different aldehydes, alcohols and acids which can at present be produced by no other means. As the reaction becomes better understood, it will become of greater importance as a reaction for the utilization of olefins. It represents one of the few truly new reactions available for commercial synthesis from petroleum.

End of Part 15. Part 16 will appear in an early issue.

Gasoline plant school: Some drove 35 miles.

Guest lecturer from instrument company: Ninety students to teach.

Off-Duty Students

WHILE CHILDREN of employes at three Shell Oil Company gas plants in Southeast Texas were preparing their home work during the last school term, many of their dads were deep in study too. Only the fathers concentrated their efforts on just one subject —a course on "Natural Gasoline Plant Operation and Technology." What puzzled the youngsters was that their elders had asked for it—attending voluntarily during their evenings off the job.

The course was held for employes of the Sheridan, Provident City, and Gohlke gas plants, with any other interested persons invited. Ninety "students" had signed up when the first class opened at the Sheridan plant's recreation hall—more than twice the number expected. Eighty-three were Shell employes (out of 108 in the three plants), four were from other companies, and two students and an instructor were from Sheridan High School. Some drove as far as 35 miles to attend.

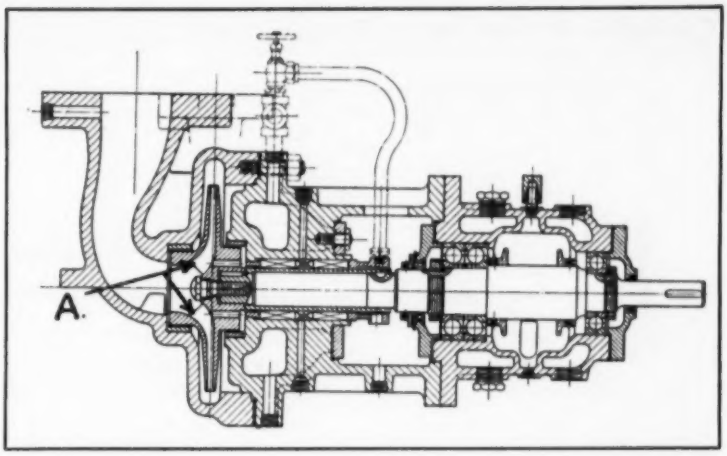
The course consisted of weekly three-hour evening classes conducted from January 25 through May 27. Subjects covered included the origin of petroleum; exploration; drilling; field operations in getting gas to a plant; gas plant operation, including absorption and compression; gas measurement; testing and treating, and carbon black manufacture.

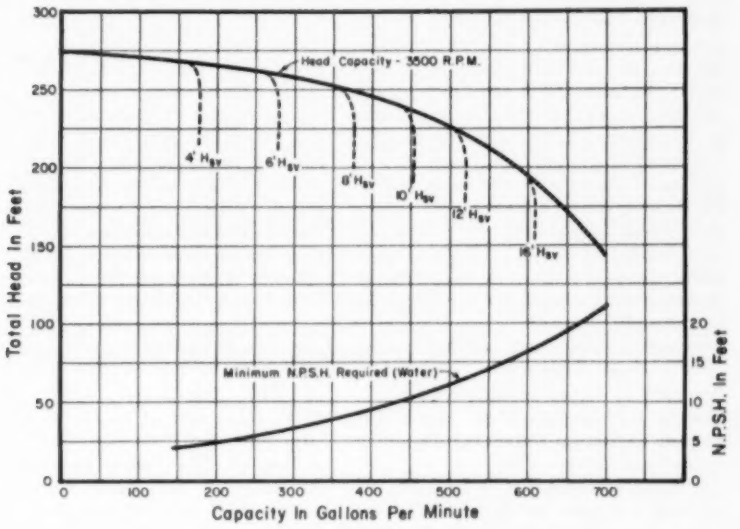
The course was given under the auspices of the Texas Education Agency with material prepared by Dr. Albert Washer, of Texas A. & M. College's Engineering Extension Service. Men from the Shell plants, qualified as part-time instructors of the college, taught the course. They included J. D. Thompson, Provident City plant superintendent; W. J. Westhoff, Sheridan plant superintendent; R. J. Thorson and W. R. Fairchild, gas engineers at Sheridan, and G. W. Leflar, Jr., gas engineer at Provident City. A guest lecturer and special films also were used.

Tests were given to let each man judge for himself how much he was getting from the course. Those completing the course received a certificate from the Texas Education Agency.

Figure 1 (top): A, is low pressure area where cavitation starts.

Figure 2 (bottom): Three-inch process pump—NPSH test with water. Dotted line shows deviation from normal when NPSH is limited.





Cavitation Versus NPSH Requirements

Serious difficulties from cavitation can often be eliminated by modifying NPSH characteristics. Follow this simple guide.

L. H. Garnar, Worthington Corporation, Harrison, N. J.

THE SIGNIFICANCE of "Net Positive Suction Head" (NPSH) as applied to centrifugal pumps has become recognized in the petroleum industry during the past ten years. A standard item on many pump data sheets, the NPSH curve is considered an important part of a process pump characteristic curve. It is important to the refiner because it may determine the maximum thruput of a unit and it may dictate such costly items as the height of vessels above the ground and the size of piping and valves. The purpose of this article is to point out that the liquid pumped influences the effects of cavitation and that in many instances when hydrocarbons are involved, the pump NPSH requirements may be modified.

The NPSH required by a pump is a measure of the energy necessary to overcome losses in the pump suction passages and to transfer liquid into the impeller vanes, without cavitation affecting the performance of the pump. Cavitation occurs when there is the formation of vapor-filled cavities in the pumped liquid as a result of the reduction of the liquid pressure at some point sufficient to cause a portion of the liquid to vaporize. In a centrifugal pump, the point of low pressure is usually at the impeller vane entrance and any cavitation starts there (see point A in Figure 1). Actually, it is the effect of cavitation on pump performance that is objectionable. The formation of vapor interferes with normal flow in the impeller changing the head-capacity relationship and the subsequent collapse of the vapor when it reaches a higher pressure area of the impeller may promote noise, vibration, erosion and corrosion of the metal.

Testing for NPSH—General practice is to design process pump impellers with as low NPSH requirements as possible. The complete pump is then tested to develop its actual NPSH requirements over its operating range. Two of the most common methods of test use water, either from a vessel where temperature and pressure can be varied or by using a throttling device in the suction line. Figure 2 shows the results of such a test on a three-inch pump, the solid line being the normal head-capacity curve and the

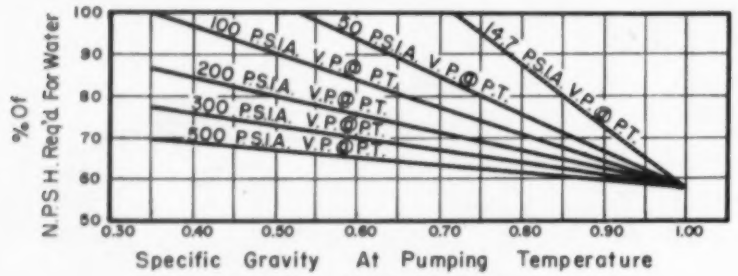


Figure 3. NPSH correction chart for hydrocarbons.

(Reprinted from Standards of Hydraulic Institute, Copyright, 1951, by Hydraulic Institute, 122 East 42nd Street, New York)

dotted lines showing the deviation from normal when the NPSH available (Hsv) is limited. The brakehorsepower and efficiency curves are omitted for the sake of simplicity. The curve plotting NPSH required against capacity shows the minimum pump performance. While the pump actually delivered 375 gpm at 8 foot NPSH, the curve shows 350 gpm as this is on the normal head-capacity curve before the "break" starts. Such tests are run with water which is a single component liquid, having definite vapor pressure-temperature values. When the pressure is lowered below the vapor pressure, water will vaporize with only a small percentage (less than 3 percent) of vapor volume required to change the head-capacity curve. The rate of cavitation influences the sharpness of the break.

Pumps selected for a capacity requiring a certain minimum NPSH on water have been found to deliver the same capacity of hydrocarbons at apparently lower NPSH. Others delivered more capacity with the same NPSH proving that under some conditions, the effect of cavitation with hydrocarbons is less drastic than when handling water. This is understandable when it is realized that hydrocarbons are generally mixtures with a boiling range instead of a boiling point and that when the pressure is reduced below the vapor pressure only the most volatile fractions are vaporized. The vapor pressure of the remaining liquid drops increases, thereby increasing the available NPSH. The amount of pressure drop to cause sufficient vaporization to affect pump performance is a function of the particular liquid and naturally varies with each hydrocarbon mixture. One gallon of 90-F. test water, could produce 3900 cubic feet of vapor at its vapor pressure of 0.256 psia, whereas one gallon of 60-F. pure propane could produce only 4.27 cubic feet of vapor at its vapor pressure of 107.1 psia or 36.4 cubic feet of vapor at 14.7 psia. Thus, it is evident that the quantity of liquid subject to vaporization and the volume of vapor may be less with hydrocarbons mixtures than with water.

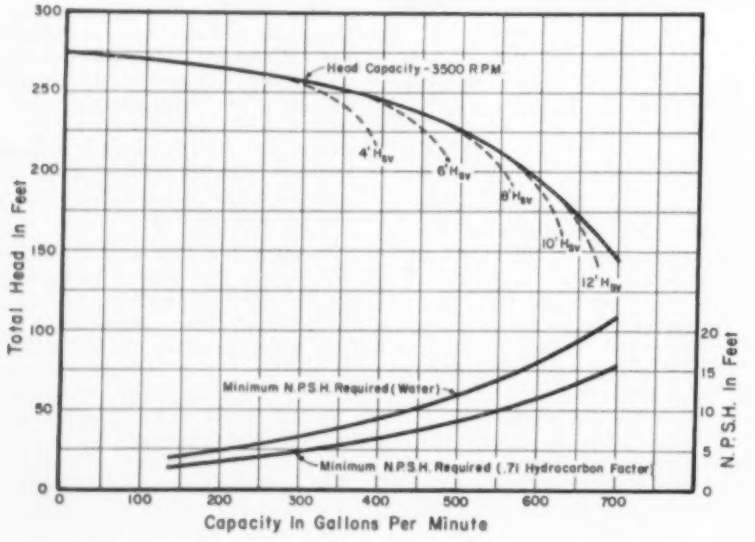


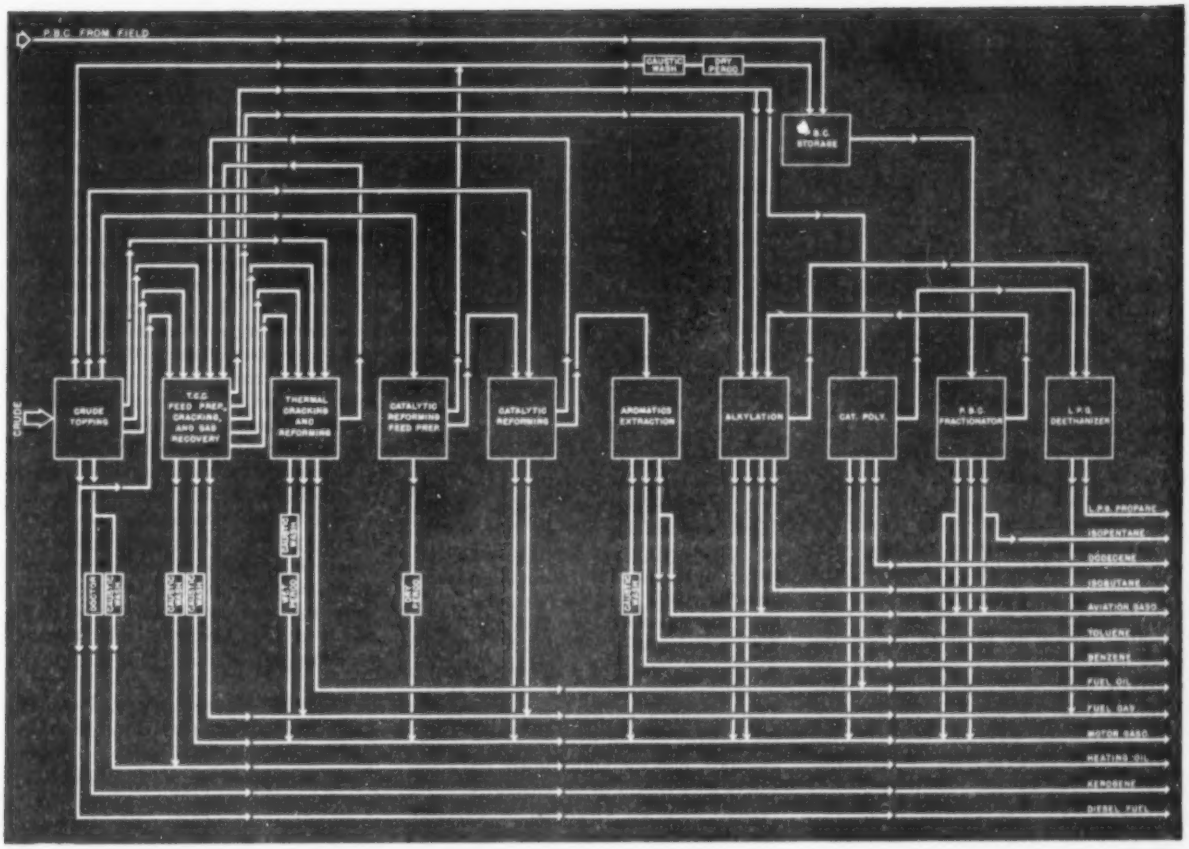
Figure 4. Comparison of hydrocarbon and water NPSH requirements.

Correcting NPSH—The next step is to arrive at a factor, based on the type of liquid, to correct the NPSH available in a system or to modify the normal NPSH requirements of the pump. At present the latter method seems more practical. Based on experience to date, the Hydraulic Institute has prepared a conservative empirical hydrocarbon NPSH correction chart as shown in Figure 3. The specific gravity and vapor pressure at the pumping temperature are used as an indication of the rate and volume of possible vapor formation and this in turn is reflected in the correction factor. For example, if the 3-inch pump in Figure 2 pumped 430 gpm in depropanizer reflux service with a liquid specific gravity of 0.56, and 300 psia vapor pressure, the hydrocarbon correction factor would be 71 percent. The NPSH required would be $10 \times 0.71 = 7.1$ feet in this service, reflecting the relatively small vapor volume at this pressure and the fact that the reflux pressure could probably be lowered without significant vapor formation. Figure 4 shows the hydrocarbon NPSH curve which is 71 percent of the water requirements of the 3-inch pump throughout its range. The dotted head-capacity curve deviation is also less drastic than on water because of the slower rate of vapor formation.

Referring again to Figure 3, the correction for an intermediate cut of 0.65 specific gravity and 50 psia vapor pressure at 450 F. pumping temperature would be 89 percent. Intermediate vapor pressures can be interpolated. No corrections are shown for hydrocarbons having a vapor pressure below atmospheric because where NPSH is involved they would be handled under a vacuum where vapor volumes are large.

Further experience may change the correction values in Figure 3 at some future date, or lead to the preparation of a different method of correction. Actually, the change in the effect of cavitation is a function of the liquid rather than of the pump and it is conceivable that each liquid may someday have a correction factor. The hydrocarbon correction factor relationship to the liquid is the same for any make of pump of similar design. The suggested basis of pump selection and comparison is to obtain NPSH requirements on water and then to apply the same hydrocarbon NPSH correction factor to all pumps.

The correction chart should not be used for liquids other than hydrocarbons or where other complicating conditions exist such as air or gas entrainment or pumping close to the cracking temperature.



Flow diagram: Facilities for special products added.

Conoco Enlarges Lake Charles Plant

◗ Crude capacity upped to 45,000 barrels per day with facilities to produce dodecene, benzene, and toluene.

◗ Volume of field condensables processed in refinery increased.

THE TEST PERIOD for new facilities in Continental Oil Company's enlarged 45,000-barrel-a-day refinery at Lake Charles, La., has recently been completed and the plant is now on full production.

The original Lake Charles refinery was put on stream in 1941. It was designed to process 10,000 barrels daily of crude and 6000 barrels daily of de-ethanized field condensables containing propane, butane, and casinghead. The process units of the original plant included crude topping; a four-coil combination of visbreaking, thermal gas oil cracking, thermal reforming, and butane reversion; sulfuric acid alkylation; thermal polymerization; and casinghead gasoline fractionation. Over the period from 1941 to the time of the recent enlargement, revisions in the processing equipment had increased the crude charging capacity to 12,000 barrels daily. For the last several years the thermal polymerization unit was operated only during the summer months when a surplus of butane existed.

Early in 1951, a decision was made to modernize and enlarge the Lake Charles refinery to a crude capacity of 45,000 barrels per stream day and install facilities to produce special products such dodecene, benzene, and toluene. In 1953 Continental also began construction of a gas processing plant at nearby Gillis, Louisiana, which will increase the volume of field condensables to be processed in the refinery.

Keeping in step with the tradition of the industry, most of the units of this

Conoco Plant . . .

refinery have operated well in excess of design capacities. A typical refinery yield balance attained with the enlarged facilities is summarized in Table 1. There is no doubt that the plant capacity might be further increased without major additional capital expenditures.

Crude Topping—The plant now contains two atmospheric crude topping units. The orginal unit was modified slightly to increase its capacity from 12,000 to 16,000 barrels daily. The new crude unit, designed to process 30,000 barrels daily has been operated at a capacity of 38,000 barrels. Each unit is complete with stabilizers and side cut strippers. The light ends, including the gases from the reflux drums, are run to storage with the field condensables. The stabilized straight run gasoline is fractionated in two 50-tray towers yielding a light fraction which is combined with the field condensables, a middle cut for catalytic reforming containing benzene, toluene, and C_8 and C_7 naphthenes, and a heavier straight run fraction which is yielded directly to gasoline. A portion of the side cut naphtha is thermally reformed and the remainder is reformed catalytically in a blocked-out operation. Kerosine and a portion of the diesel fuel fraction are yielded directly to storage. The balance of the diesel oil and atmospheric gas oil are charged directly to the catalytic cracking units.

Lubricating Oil Stocks—A portion of the topped crude produced on the new crude unit is transferred by pipe line to the Cit-Con Oil Corporation's lubricating oil plant, located about seven miles from the Continental refinery. The balance of the topped crude is yielded directly to one of the catalytic cracking unit feed preparation sections. At the Cit-Con lube oil plant the topped crude is vacuum distilled producing raw lube cuts which are processed by the latest techniques to produce lubricating oils and waxes. Two streams are returned from the Cit-Con plant to the Conoco refinery. One stream is a blend of gas oil, slop waxes, and extracts from the solvent extraction of distillate lube fractions. This stream is catalytically cracked at the refinery. The other stream, a residual extract from bright stock operation is returned separately for visbreaking.

PBC Fractionation—The PBC material, so-called because it is a mixture of propane, butane, and casinghead, is a combination of field condensables and light ends from crude distillation and straight-run gasoline superfractionation. This material is first charged from pressure storage spheres to a deisobutanizer. Propane and isobutane are taken overhead to a depropanizer, and the bottoms are fed to a debutanizer, thence to a deisopentanizer to produce normal butane, isopentane, and denuded casinghead. The bottoms from the depropanizer are fed to the alkylation unit, and the overhead becomes propane LPG after de-ethanization. A recycle condensate stream from the alkylation unit is fed into this same depropanizer in order to purge propane from the alkylation system.

Catalytic Cracking—Two new TCC catalytic cracking units are contained in a joint structure and feed into a common fractionation system. These are of the modern Socony design employing gas lift catalyst circulating systems. The two cat crackers have separate feed preparation facilities, the one feed preparation system being designed to feed only distillate stocks consisting of a charge drum, a vaporizer furnace, and a flash drum. The overhead vapors feed directly to the reactor of the first catalytic cracking unit, and the bottoms are fed separately as a liquid to the reactor without further heating. The feed preparation system of the second cat cracker differs from that of the other unit in that a vacuum flash tower is employed. The feed to this cat cracker includes, together with light virgin gas oil, the excess topped crude over and above what is pumped directly to the Cit-Con lube plant. The overhead vapors from the flash drum or tar stripper feed directly to the reactor. The bottoms from the tar stripper feed directly without further heating into the vacuum flash tower. The total gas oil flashed from the tar stripper bottoms is condensed and withdrawn from the vacuum tower as a warm side cut, is then preheated, and charged to the second reactor in liquid phase. The vacuum tower bottoms are charged hot into the thermal unit for visbreaking. The gas oil-distillate extract-slop wax mixture from Cit-Con is charged to the first cat cracker to insure that the total stream will be fed into the reactor.

The products from the fractionation system include: rich gas and unstabilized gasoline which are fed to the vapor recovery system, heating oil which is produced as a side cut and steam stripped, and a heavy gas oil from the bottom of the fractionator which is fed directly to the thermal cracking unit.

TABLE 1

Over-All Refinery Balance

	BPCD
Fuel gas (F.O.E.)*	(1,504)
Propane L.P.G.	2,227
Isobutane	654
Isopentane	1,063
Pentanes	414
Denuded C.H.	531
Light Alkylate	2,232
Toluene-xylene	270
Total 115/145 Avgas	**3,447**
Butanes	2,190
Denuded C.H.	1,103
Raffinate from aromatics extr.	1,966
Straight run	4,990
Heavy platformate	1,728
Thermal cracked and reformed	2,761
Cat cracked	7,491
Cat poly	174
Heavy alkylate	168
Total 10-lb. gasoline	**22,571**
Benzene	352
Toluene-xylene	826
Dodecene	378
Kerosine	2,355
Regular diesel	1,325
Kerosine	333
Regular	1,000
Total special diesel	**1,333**
Kerosine	3,212
Cycle heating oil	6,106
Total heating oil	**9,318**
Carbon black distillate	430
Net lubes and waxes (Cit-Con)	2,723
Heavy fuel oil	4,345
Field condensables	3,772
Crude	50,000
Total Charge	**53,772**

* Fuel oil equivalent.

Thermal Cracking and Reforming—The thermal cracking unit includes four heating coils, a soaking drum, a combination evaporator and heavy gas oil tower, a pressure bubble tower, vapor phase clay treating towers, an afterfractionator, an absorber, a stabilizer, and a fuel oil flash system. The total fresh charge includes about 7000 barrels daily of residual stock and a catalytic cycle gas oil and about 2300 barrels daily of heavy straight-run naphtha. The effluent from the several thermal coils join and pass through the soaking drum enroute to the fractionation system. The products from thermal cracking include absorber gas which is yielded directly to the fuel gas system, stabilizer over gases and liquids which are further processed in the main vapor recovery unit, stabilized cracked gasoline, and a refractory cycle gas oil which is delivered to the adjacent oil carbon black plant.

Catalytic Reforming—The catalytic reforming unit (UOP design) processes two types of stock on blocked-out operation. This is a four-reactor unit designed to operate at 500 pounds pressure when processing heavy naphtha for octane improvement and at 250 pounds pressure when processing superfractionated light naphtha for production of aromatics. The two charge naphthas are accumulated in storage tanks to permit reasonable long runs on either stock. The stabilized heavy reformate is yielded directly to gasoline. The depentanized light reformate is yielded to inter-

mediate storage from which it is charged to the aromatics extraction unit. The overhead gas and liquid from the stabilizer are charged to the main vapor recovery unit, and the gas from the products separator passes through an absorber before being yielded to fuel gas. A stream of side cut gas oil from the cat cracker fractionator is charged to the absorber as lean oil, and the rich oil is returned to the cat cracker fractionator so that all light ends recovered in the reformer absorber are ultimately charged into the main vapor recovery system.

Vapor Recovery—The rich gas from the cat crackers is compressed in two stages to 225 psig. It is recontacted with the unstabilized cat cracked gasoline at both the interstage and final pressures. The overhead vapor and liquid streams from the thermal cracking and reforming stabilizers are fed into the interstage recontact system of the main vapor recovery unit. The total vapor-liquid mixture at 225 psig is charged into an absorber-stripper column. Debutanized cat cracked gasoline is charged to the lower absorption section as lean oil. The rich oil from this section descends through the stripping section together with the liquid portion of the fresh feed. The upper absorption section is separated from the lower absorption section by a liquid-tight deck. A side cut gas oil fraction from the cat cracker fractionator is charged as lean oil to the upper absorption section with rich oil returning to the cat cracker fractionator for recovery of gasoline components stripped from the lighter lean oil. The bottoms from the absorber-stripper are charged to a stabilizer which operates totally condensing and takes as an overhead product a combined C_3-C_4 fraction together with as much C_5 fraction as is desired to charge to the alkylation unit. The net bottoms from the stabilizer are yielded to storage for gasoline blending. The C_3-C_4-C_5 fraction is charged through a 3-stage caustic scrubber, then through a 3-stage water scrubber to a depropanizer. The bottoms from the depropanizer move to the alkylation unit feed drum after cooling. The depropanizer overhead is dried by distillation by passing it through a 20-tray reboiled stripper. The overhead vapors from this stripping column combine with the overhead vapors from the depropanizer, passing through the condenser into the depropanizer reflux drum from which water is withdrawn. The dry propane-propylene fraction from the bottom of the stripper is cooled and fed to the catalytic polymerization unit. At times a portion of this stream

Refinery at Night: As pretty as it is functional.

is charged to the alkylation unit. Water condensate streams from the high pressure vessels of the vapor recovery unit are not released directly to the sewer but are returned to the reflux drum of the catalytic cracking unit to reduce the hazard in discarding this condensate.

Alkylation—The sulfuric acid alkylation unit is of the autorefrigeration type, having a design capacity in excess of 2500 barrels daily of true alkylate. Primary equipment are two reactors which operate in series, caustic and water wash facilities for the reactor effluent, an isobutane tower, a debutanizer, a rerun tower, and four compressors having a total capacity of 1600 bhp. A depentanizer is now being installed to operate between the debutanizer and rerun towers to permit the charging of more amylenes to the unit. The new equipment added as a part of the enlargement program includes a new three-stage cascade-type reactor, two new 500-hp compressors, a new and larger rerun tower, additional heat exchangers and reboilers, and several new pumps. The fresh feed to the alkylation unit includes the butane-butylene fraction from the main vapor recovery unit, an isopentane-amylene fraction, and at times a portion of the propane-propylene, together with a relatively high purity isobutane fraction from the light end fractionation system. All recycle isobutane, propane-propylene, and a portion of the butane-pentane fraction are charged into the first reactor, which is divided into two compartments, the first being the reaction compartment which overflows into the settling compartment. Emulsion is continously circulated in the reaction compartment by external pumps which discharge directly back into the same compartment through distribution spiders. The hydrocarbon feed to the reactor enters with the recycle emulsion. This reactor is cooled by autorefrigeration. A slipstream of this refrigeration condensate is returned to the reactor via the depropanizer for purging propane from the system.

The hydrocarbon effluent from the settling compartment of the first reactor enters the second reactor which contains three reaction sections in series plus a settling section. The olefin-bearing butane-pentane fresh feed enters the second reactor through the stirring shafts into the three reaction sections in parallel. This reactor is similarly cooled by autorefrigeration. The effluent from the settling compartment of the second reactor is charged through caustic and water scrubbers in series, thence to the isobutane tower. Isobutane, taken overhead, is recycled to the first reactor, and the bottoms are fed to the debutanizer. Normal butane is taken overhead from the debutanizer to storage for gasoline blending, LPG sales, and seasonally for thermal polymerization.

In the ultimate scheme the bottoms from the debutanizer will flow to the dependanizer, producing overhead a stream of isopentane suitable for Avgas blending and a bottom stream of total alkylate with a vapor pressure of about 6.5 pounds. The bottoms from the dependanizer will pass next to the rerun tower to produce an overhead fraction of aviation alkylate and a bottoms product of heavy alkylate which is used in motor gasoline blending.

Fresh acid is first fed to the No. 2 reactor in which it becomes partially spent. It is then transferred to the No.

Conoco Plant . . .

1 reactor from which it is withdrawn to spent acid storage for return to the acid supplier. By using this series flow scheme for reaction, that portion of the alkylate made in the last compartment of the second reactor is produced under conditions that would exist in a single-stage reactor operating with a 6-1 isobutane-olefin ratio. Progressing forward from this point, each reaction stage operates under progressively more favorable conditions. Reuse of the original isobutane tower and debutanizer for the six-fold expansion was made possible by better fractionation of the isobutane feed to reduce the amount of normal butane entering the system and by having a substantial excess of isobutane in the total fresh feed.

Catalytic Polymerization—Primary equipment in the catalytic polymerization unit includes six tubular reactors, a depropanizer, a recycle tower, and a dodecene rerun tower. Light polymers, including dimers and trimers, are recycled to the first set of three reactors which operate in parallel. Half of the propane-propylene fresh feed enters the first set of three reactors in mixture with the recycle light polymers. The balance of the propane-propylene fresh feed is mixed with the effluent from the first set of three reactors, and the combined stream passes through the second set of three reactors in parallel, thence to the depropanizer. The overhead product from the depropanizer joins with the overhead product from the light end depropanizer to be de-ethanized to produce propane LPG. The bottoms from the depropanizer pass next to the recycle tower from which an overhead stream is recycled to the reactors with the overhead net make being yielded to motor gasoline. The bottoms from the recycle tower are distilled in the rerun tower to produce as an overhead product specification propylene tetramer (dodecene), and a bottoms of heavy polymer. Proper catalyst hydration is maintained by separately injecting water into the feed streams to each set of reactors.

Aromatic Extraction—Aromatics are separated from the non-aromatics in the light reformate stream by liquid extraction with sulfur dioxide at a temperature of about —24 F. The non-aromatics stream is yielded to motor gasoline; whereas the aromatics are fractionated to yield benzene which is shipped along with the dodecene to Continental's petrochemical plant at Baltimore, Maryland. The bottoms product from the benzene distillation is a mixture of toluene and xylene of high purity which is used in blending aviation gasoline. By the addition of another column and simple treating facilities, nitration grade toluene and xylene may be produced. The low temperature in the extraction column is obtained by auto-refrigeration, the recycle SO_2 being the refrigerant. Sulfur dioxide is very corrosive when wet; therefore the reformate feed is passed through alumina driers enroute to the extraction column.

Thermal Polymerization—The thermal polymerization is used intermittently for converting saturate propane and butane to motor gasoline when an excess of these materials develops.

Treating. The field condensible stream does not require chemical treatment. The light ends from straight run stabilization and superfractionation units are caustic washed and Perco sweetened (dry process) before passing to storage with the field condensibles. The heavy straight run gasoline from superfractionation is Perco sweetened (dry process) before blending. The thermal cracked gasoline is sweetened by the liquid Perco process. The cat cracked gasoline is air-caustic sweetened in a three-stage scrubber. The cycle heating oil from catalytic cracking passes through a three-stage caustic scrubber enroute to storage. The kerosene is doctor sweetened when necessary, but normally this stream requires only caustic washing. The straight run diesel fuel and reformate do not require chemical treatment.

Waste Disposal—The spent caustic from the cat cracked gasoline scrubber is neutralized with hydrogen sulfide by contacting it with the absorber tail gas before the latter passes to the fuel system. This neutralization springs out the acid oils which are decanted from the resulting sodium sulfide solution. The sulfide solution from the acid oil springing tank together with other alkaline wastes is transferred to a holding drum from which it is bled gradually into the refinery effluent water stream or shipped to a purchaser of the material. Discard waters from the cooling system pass through a large basin for settling and skimming before they are discharged to the bayou. Oil-bearing waste waters pass through a separator to recover the oil before the waters are discarded to the bayou. All recovered oil is processed through the thermal cracking unit.

Utilities—The main steam plant consists of four water tube boilers, each with a capacity of 85,000 pounds per hour of steam at 350 psig and 600 F. Makeup water for the boilers is treated by the hot lime-soda process. Considerable steam is generated at 350 psig in the kiln waste heat boilers at the two cat cracking units. Electric power is supplied by four condensing turbine-driven generators, each rated at 2500 kva. The water supply for process cooling includes 6000 gpm of 73 F. water direct from wells and 58,500 gpm of circulating water from the induced draft cooling towers. Steam is available for processing at 350, 150, and 20 psig. Pump drivers were carefully selected to insure maximum power realization from the steam before use in processing. To permit satisfactory balancing of three steam systems under all plant loads, several process turbines were designed to use 350-pound steam and operate condensing; others to use 350-pound steam and exhaust to the 150-pound system; while some units use 350-pound steam and 150 steam and exhaust to the 20-pound system.

Storage and Loading—The refinery tankage includes 101 tanks totaling 4,975,000 barrels. Of this nine tanks totaling 1,140,000 barrels are in crude service; seven tanks totaling 220,000 barrels are used in connection with transfers to and from the Cit-Con lubricating oil plant. Twelve tanks totaling 232,500 barrels are used for intermediate products, and 15 pressure storage vessels totaling 164,000 barrels are used for propane LPG, butane, butylenes, isobutane, isopentane, and PBC. Several large tanks are manifolded for dual service. Distillates are stored in these tanks during the summer months for winter movement; and gasoline is stored in them during the winter months for summer movement.

The plant is complete with racks for loading products into tank cars and trucks and two tanker docks and one barge dock on the Calcasieu river for loading all products and unloading crude.

Crude is delivered to the refinery by pipe line, barge and tanker. Field condensibles enter by pipe line. Two insulated pipe lines connect the refinery with the Cit-Con lube oil plant, and one small pipe line connects the refinery with that of Cities Service about seven miles distant.

Contractors—The prime contractor for the new process units, except the platformer, and for the alky revamp was the Badger Process Division of Stone and Webster Corporation. The platformer was built by UOP's affiliate, Procon.

Personnel—The total personnel in the plant is 367.

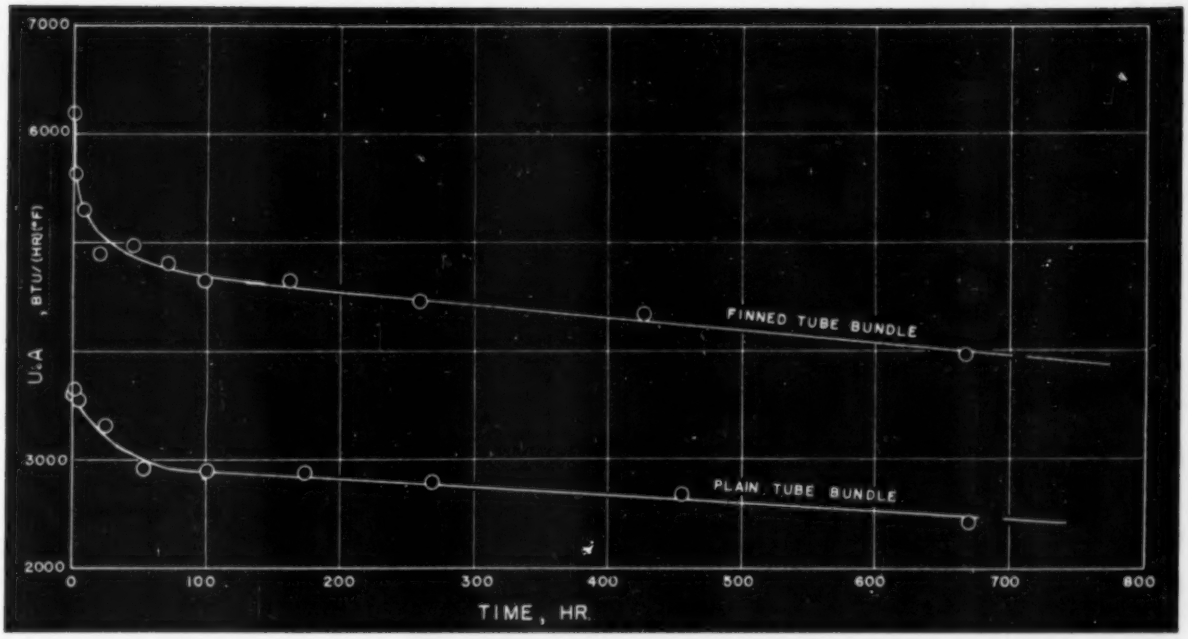


Figure 1. Variation of heat transfer performance with time (A = Total outside area, 79.00 square feet finned, 38.25 square feet plain).

Fouling of Heat Exchangers

◗ Tests indicate fouling factors are about the same for finned tubes as for plain tubes.

◗ Solution cleaning of fouled finned tubes can restore heat transfer to its initial condition.

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HOW DO FOULING factors for plain and finned tubes compare? These tests, using No. 5 fuel oil and continuous circulation for a month through plain and finned tube bundles, indicate the two are similar.

The deposition of solids on heat exchange surfaces, commonly called fouling, reduces the rate of heat exchange over that obtained for clean exchangers. For many fluids the rate of fouling has been established for design purposes by TEMA (Tubular Exchanger Manufacturers Association)[7] as an added resistance which should be included in the heat transfer equation to obtain the expected rate of heat transfer after fouling has occurred. This fouling factor represents the increase in resistance to heat transfer which may be expected in various services before the heat exchanger should be cleaned.

Specific data have been published on fouling rates for refinery product streams[3] showing the variation of overall fouling resistance with time. Data are presented on heavy naptha, crude oil, furnace oil, gas oil feed, reduced crude, and absorption oils for plant tests varying from three to ten months after cleaning.[6,8]

For finned tubes used in shell and tube exchangers, fouling data have been reported by Armstrong[2] in such services as quench oil and lubricating oil. Ames and Newell[1] report that condensers of normal butylene have been in service for two and one-half years without noticeable fouling on the shell side of low finned tubes.

Experimental Data—The effect of fouling on finned tubes as compared with plain tubes naturally follows the study of comparative heat exchange in the clean condition.[10] In the same experimental apparatus which was used for the heat exchange test, No. 5 fuel oil was circulated on the shell side of both a plain and a finned tube unit for approximately one month. The fuel oil was cooled by water circulating through the tubes of the exchanger and was heated by passing through the shell side of another exchanger with steam inside the tubes. The oil was heated to about 160 F. and cooled to 140 F. It came in contact with air in an open storage tank. Oxidation and evaporation of light fractions in this oil changed the viscosity and density during the test as given in Table 1. In making calculations, the specific heat and thermal conductivity of the oil were obtained from Nelson.[5]

Heat transfer data were obtained

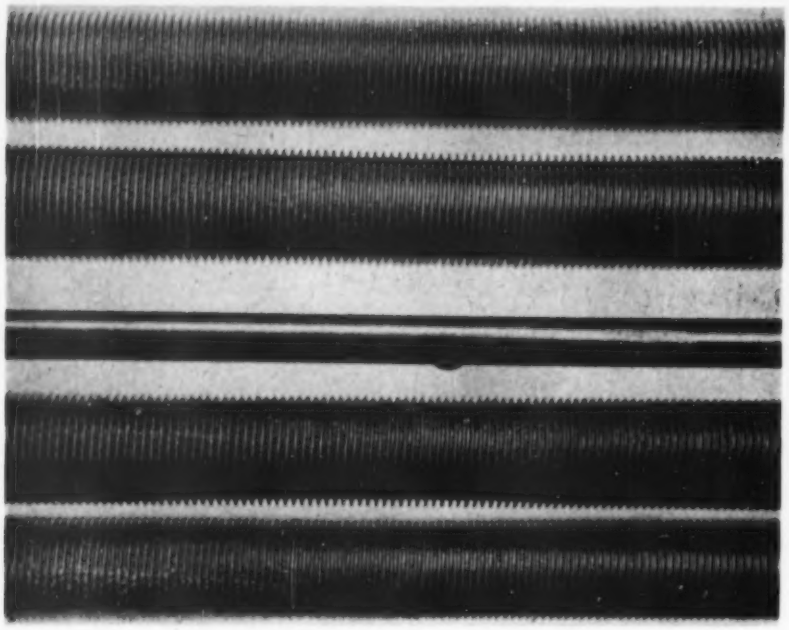

Figure 2. Fouled finned tubes in a fuel oil heat exchanger.

shortly after starting the equipment and again at intervals over the four weeks during which the oil and water flow rates through the exchanger were maintained constant. Prior to shutting down the equipment, the oil flow rate was varied in order to determine the effect of flow rate on the over-all coefficient and on the fouling factor. At the end of this test the exchanger bundles were cleaned by circulating a mixture of kerosine, water and detergent and the over-all coefficient again determined. Example experimental data obtained during fouling are given in Table 2.

Calculation of Fouling Rate Factors—To calculate the fouling factor, it is necessary to calculate the individual heat transfer coefficients for the inside and the outside of the tubes using equations found by Williams and Katz[9,10] for these exchangers. The fouling factor may be calculated from Equation 1.

$$\frac{1}{U_o} = \frac{1}{h_o} + \frac{X_f A_o}{k_m A_m} + \frac{A_o}{h_i A_i} + r \quad (1)$$

where

U_o = Overall coefficient of heat transfer, Btu/(hr) (°F) (ft² outside area)
h_o = Outside film coefficient, Btu/(hr) (°F)(ft² inside)
h_i = Inside film coefficient, Btu/(hr) (°F)(ft² inside)
A_o = Outside tube surface area, ft²/ft
A_i = Inside tube surface area, ft²/ft
A_m = Logarithmic mean metal area, ft²/ft
k_m = Thermal conductivity of tube wall. (Btu)(ft)/(hr)(°F)(ft²)
X_f = Tube wall thickness, ft.
r = Over-all fouling resistance based on outside area, (hr)(°F)(ft²)/Btu

The over-all fouling factor (r) includes the increased resistance due to fouling on both the outside and inside of the tube.

Figure 2 is a photograph showing the degree of accumulation of material on the finned tube exchanger at the end of the four weeks. Figure 1 shows the variation in heat transfer per degree temperature difference as a function of time for the two exchangers. Figure 3 shows the variation of fouling factor with time for the two exchangers along with data from the literature. Figures 4 and 5 show the variation of over-all coefficient of heat transfer with oil mass velocity for initially clean tubes, fouled tubes, and tubes which have been cleaned after a fouling test.

It may be seen that the resistance to heat transfer increases rapidly at first and then levels out to a very small rate of increase. At the end of the test, the fouling factors for both bundles were below the value of 0.005 which is specified by TEMA[7] for the oil of this type. It should be noted that the fouling factor measured experimentally includes the inside resistance as well, but this probably is a small resistance in these tests. The decrease in performance due to fouling alone was 25 and 22 percent for the finned tube and plain tube bundles respectively. An extrapolation to a six-month period would indicate 31 and 32 percent for these two bundles respectively.

Without knowledge of the flow mechanism for the oil going through a finned tube bundle, the question naturally arises as to why more sediment is not deposited between the fins. The work of Knudsen and Katz[4] indicated that the flowing stream dips into the space between the fins in turbulent eddies. This turbulence no doubt is responsible for the general lack of deposition of material between the fins.

The tests indicate that the fouling of

TABLE 1
Variation of Specific Gravity and Viscosity with Time

SERIES I—8-inch Finned Tube				SERIES II—8-inch Plain Tube			
TIME AFTER TEST BEGINS, HOURS	Specific Gravity at 60 F.	Viscosity Saybolt Universal Sec		TIME AFTER TEST BEGINS, HOURS	Specific Gravity at 60 F.	Viscosity Saybolt Universal Sec	
		120 F.	160 F.			120 F.	160 F.
0.5	0.9514	239.6	112.1	0.5	0.9525	267.8	118.6
2.5	0.9501	244.7	112.2	2.0	0.9525	261.2	122.0
8.75	0.9514	250.3	110.8	5.58	0.9524	263.8	126.2
20.25	0.9523	273.3	116.4	25.00	0.9543	285.8	130.9
45.00	0.9544	287.0	122.4	54.33	0.9564	329.6	140.6
71.75	0.9556	302.9	129.1	101.25	0.9573	376.4	139.4
99.00	0.9559	320.2	130.2	174.00	0.9584	380.2	155.2
162.25	0.9564	331.2	140.4	268.50	0.9598	414.4	163.6
260.0	0.9582	367.8	145.3	456.00	0.9618	460.4	181.0
427.50	0.9610	451.1	168.7	671.25	0.9649	563.2	206.7
667.50	0.9638	570.5	208.6				

TABLE 2
Some Experimental Data for Fouling with Time at Constant Flow Rate

	ADMIRALTY TUBES IN 8-INCH TUBE BUNDLE			
	SERIES I—¾-inch Finned		SERIES II—¾-inch Plain	
Water				
Temperature In, F.	95.59	95.7	96.69	94.41
Temp. Out, F.	101.91	99.9	100.6	97.27
Flow Rate, Lb/Hr	48,150	50,200	49,400	50,100
Heat Transferred, Btu/Hr.	304,000	211,000	192,800	143,000
Oil Side				
Temperature In, F.	155.37	155.8	157.39	160.07
Temp. Out, F.	139.64	144.9	146.59	150.73
Flow Rate, Lb/Hr	39,200	38,250	37,430	31,400
Heat Transfer, Btu/Hr	284,000	192,000	186,000	134,800
Log Mean, ΔT, F., Corrected	49.0	53.2	53.2	59.0
Over-all Coefficient Btu/Hr-°F-Sq Ft Outside	78.5	50.2	94.6	63.2
Outside Film Coefficient, h_o	87.8	71.0	126.5	98.5
Total Fouling Resistance, Hr-°F-Sq Ft. out/Btu.	negligible	0.00400	0.00182	0.00483
Time, Hr.	0.5	667.50	0.5	671.25

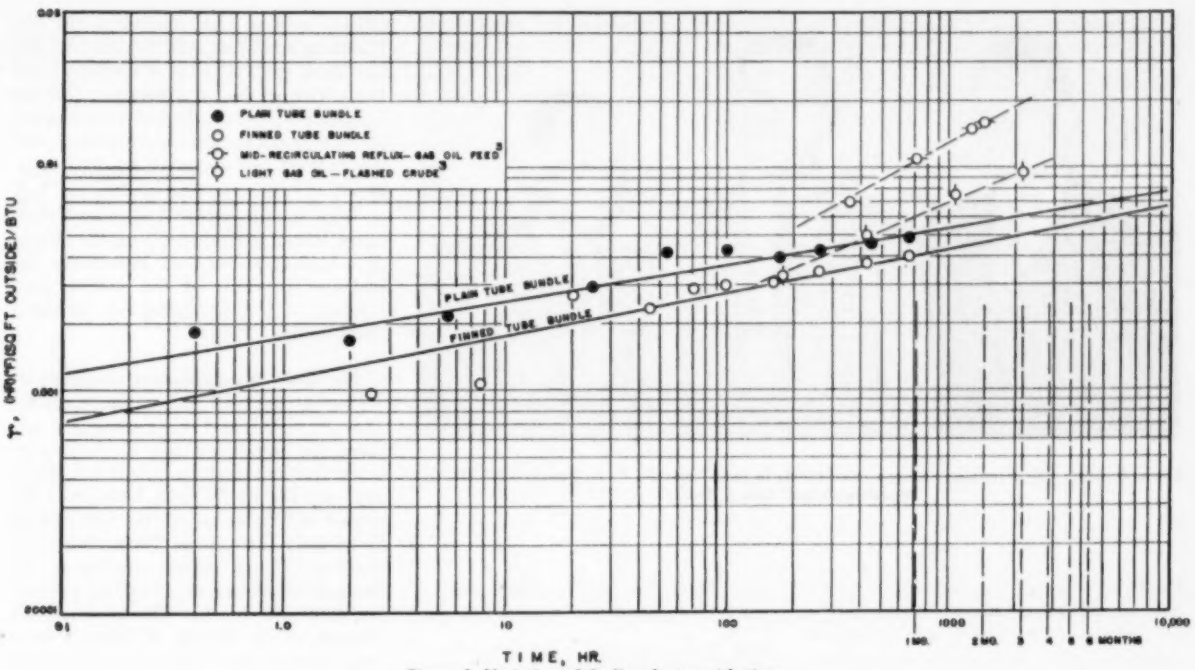

Figure 3. Variation of fouling factor with time.

finned tubes is likely to be similar to that of plain tubes with comparable percentages of reduction in performance. Therefore, TEMA fouling factors appear to be suitable for the design of exchangers with finned tubes as well as plain tubes. The cleaning of both bundles by kerosine-water-detergent emulsion restored the heat transfer to essentially its initial condition and hence solution cleaning of finned tube bundles should be as successful in similar services as for plain tube bundles.

ACKNOWLEDGMENT

Permission by Wolverine Tube Division of Calumet and Hecla Incorporated to publish this paper is appreciated.

REFERENCES

[1] Ames, G. W., Newell, R. G.: Chemistry in Canada, January, 1954.

[2] Armstrong, R. M.: *Trans. ASME*, **67**, p. 675 (1945).

[3] Butler, R. C., McCurdy, W. N., Linden, N. J.: *Trans. ASME*, **71**, p. 843 (1949).

[4] Knudsen, J. G., and Katz, D. L.: *Chem. Eng. Progress*, **46**, pp. 490-500 (1950).

[5] Nelson, W. L.: *Petroleum Refinery Engineering*, 2nd Edition, McGraw-Hill, New York, 1942.

[6] Nelson, W. L.: *Oil and Gas J.*, **45**, No. 3, p. 141, May 25, 1946.

[7] *Standards of Tubular Exchanger Manufacturers Association*, 2nd Edition, TEMA, Inc., New York, N. Y., 1949.

[8] Welland, J. H., McCay, R. C., Barnes, J. E.: *Trans. ASME*, **71**, p. 849 (1949).

[9] Williams, R. B., and Katz, D. L.: *Trans. ASME*, **74**, p. 1307 (1952).

[10] Williams, R. B., and Katz, D. L.: *Petroleum Refiner*, **33**, p. 145 (March, 1954).

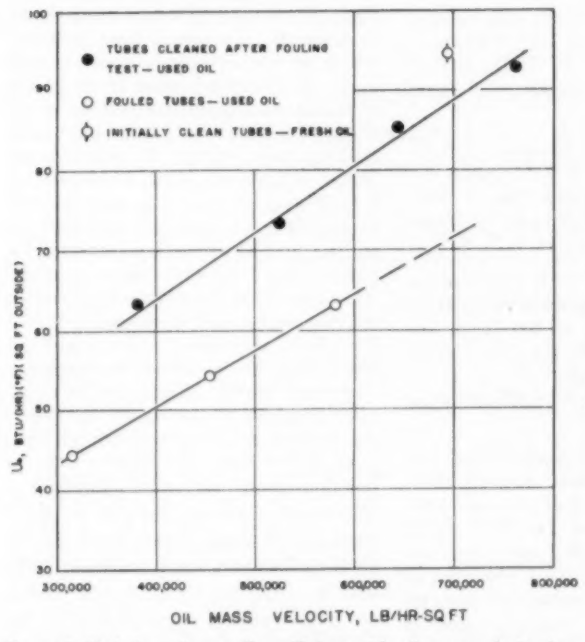

Figure 4. Variation of over-all coefficient with oil mass velocity for finned tube bundle.

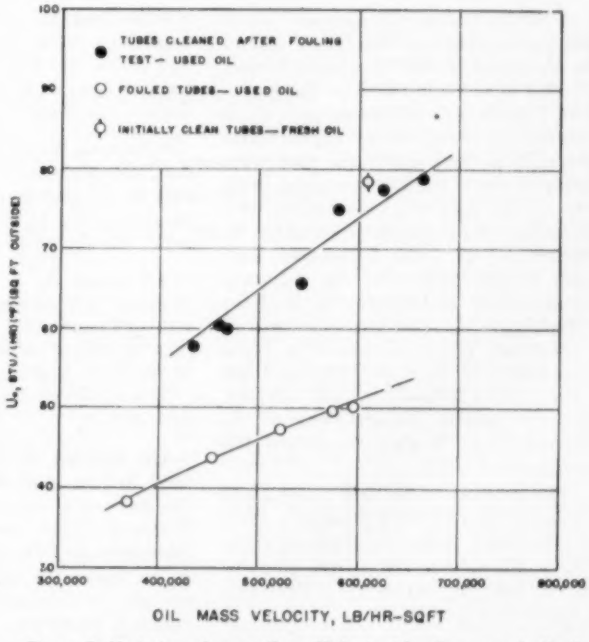

Figure 5. Variation of over-all coefficient with oil mass velocity for plain tube bundle.

These directors will determine nitrogen constituents in petroleum: Dr. C. A. VanderWerf, Dr. Guy Waddington, and John S. Ball.

Nitrogen in Petroleum To Be Studied

A NEW PROJECT named "Nitrogen Constituents in Petroleum" and to be identified as API Research Project 52, has been established by the American Petroleum Institute as part of its continuing program of fundamental research on the composition and properties of crude oil. The inaugural meeting of the Advisory Committee and Directors of the project took place on March 27, in 1954, Lawrence, Kan. with a membership of the Advisory Committee as follows: G. R. Lake (chairman), Union Oil Company of California; Harry Levin, The Texas Company; A. P. Lien, Standard Oil Company (Indiana); F. P. Richter, Socony-Vacuum Laboratories; C. K. Viland, Tide Water Associated Oil Company.

The program of the new project will resemble that of API Research Project 48 which, after six years of activity, is producing significant amounts of new information on the sulfur compounds in petroleum.

The project will be divided into three sections as follows:

- **Section 1,** on "Fundamental Studies on Separation and Synthesis," will be located at the University of Kansas, Lawrence, with Dr. C. A. VanderWerf as director.
- **Section 2,** on "Sample Preparation, Properties, and Segregation," will be located at the Laramie, Wyo. Station of the U. S. Bureau of Mines under the directorship of J. S. Ball.
- **Section 3,** on "Thermodynamic Studies," will be located at the Bartlesville, Okla. Station of the U. S. Bureau of Mines under the directorship of Dr. Guy Waddington.

The project started officially on July 1.

Dr. Calvin A. VanderWerf was born in Friesland, Wis., June 2, 1918. He received the A.B. degree from Hope College and the Ph.D. from Ohio State in 1941. Beginning in 1941, as an instructor at the University of Kansas, he has remained at that institution where he is now professor of organic chemistry. Dr. VanderWerf is active in American Chemical Society affairs, and is Chairman-elect for the Division of Chemical Education. He has been employed as a civilian with the Office of Naval Research. During his teaching career, he has co-authored two textbooks on general chemistry and has carried out an active research program.

With the advent of American Petroleum Institute Project 52 on the Nitrogen Constituents of Petroleum, he becomes Director of the section pertaining to the chemistry of nitrogen compounds.

Dr. Guy Waddington was born in Victoria, British Columbia, Canada, May 22, 1904, and is a naturalized citizen. He received his B. A. degree from the University of British Columbia, and his Ph.D. from California Institute of Technology. He taught at California Institute of Technology and Rollins College before coming to the Bureau of Mines in 1943. At present he is chief of the Thermodynamics Branch at the Bureau of Mines Petroleum Experiment Station at Bartlesville. Dr. Waddington received the Department of the Interior Distinguished Service Medal in 1953 for his work on the thermodynamics of hydrocarbons and related compounds. He is associate director of API Project 48 on Sulfur Compounds of Petroleum, and a director of API Project 52 on Nitrogen Constituents of Petroleum.

John S. Ball was born in Hamlin, Texas, August 2, 1914. He received the B.A. and M.A. degrees from the University of British Columbia, and the Ph.D. from the California Institute of Technology. He was a post-doctoral fellow at the California Institute of Technology and professor of chemistry at Rollins College before coming to the Bureau of Mines in 1943. Since 1938 Ball has been with the U. S. Bureau of Mines at Laramie, Wyo. At present he is in charge of groups concerned with petroleum chemistry and refining studies and shale-oil composition studies. He is associate director of the API Project 48 on Sulfur Compounds of Petroleum, and a director of API Project 52 on Nitrogen Constituents of Petroleum. He is active in American Chemical Society affairs, and is councilor from the Wyoming Section. He is on the executive committee of the Division of Petroleum Chemistry, and a member of the Council Committee on Membership Affairs. He will be chairman of the Petroleum Week of the Gordon Research Conferences in 1956. The Washington, D. C., Junior Chamber of Commerce honored him as one of the ten outstanding young men in Federal Service for 1953.

From single pass data . . .

Recycle Process Material Balance

Graphs provide quick way to translate conversion, efficiency and yield relationships from a single-pass to a recycle basis.

Oran L. Culberson,
Celanese Corporation of America,
Clarkwood, Texas

AS LONG AS recycle material behaves in the same way as fresh reactants do, the results of an experiment without recycle can provide just as much information as does the study where actual recycle is used. Of the many investigations being conducted today on reactions involving hydrocarbon or other chemical systems, the great majority are on a single-pass, or once-through, basis. This is a natural consequence of the simplicity, economy and rapidity with which the system having no recycle streams can be operated.

While the once-through operation is a boon to the man responsible for covering a lot of research ground, it is something less than that to his colleague who is following the process with an eye toward possible commercial application. The application-minded observer must transfer the single-pass results through a set of conversion-efficiency-yield relationships in order to obtain numbers having commercial significance. The mathematical relationships of conversion, efficiency and yield to each other of course depend upon the definitions of these terms. In this discussion the following definitions are used:

Conversion—The fraction of feed material reacted.

Efficiency—The fraction of reacted feed material converted to a given product.

Yield—The amount of given product formed by the reaction per unit of reactant in the fresh feed.

Other terms which can lead to confusion unless clearly understood are:

Gross Feed—The total feed material to the reactor.

Fresh Feed—Gross feed less recycle feed to the reactor; in a single-pass operation, the total feed.

It will be noted that conversion and efficiency are dimensionless. Therefore, these quantities can be calculated in any convenient units such as weight, mole or volume as long as the same units are applied to feed and product streams. Yield may be described in several ways. One common method is to state yield in moles per mole. This is not a dimensionless function since one of the quantities refers to the product and the other to the reactant. In many instances, it is desirable to express yield in the units for which prices are commonly quoted, e.g., pounds of product per gallon of reactant. This variation in the use of yield units requires that careful attention be given to the mathematical use of this term.

Using the above definitions, the quantitative relationships among conversion, efficiency and yield are shown in Expressions 1 to 6. The notation used there is given at the end of this article.

"It is often the case that the person studying experimental results is far removed from the man who made and reported the experiment. The experimenter may have found it more desirable to report his once-through results as a certain efficiency at a given conversion rather than a yield."

Probably the most significant bit of experimental information is an observation that if a certain amount of reactant is introduced into a single-pass reactor, a given quantity of product is obtained. This might be reported in any convenient units:

$$Y'_j = \text{observed units of product/unit of reactant in fresh feed} \quad (1)$$

It is often the case that the person studying experimental results is far removed from the man who made and reported the experiment. The experimenter may have found it more desirable to report his once-through results as a certain efficiency at a given conversion rather than the yield of Expression (1). The once-through yield is the product of conversion and efficiency where the reaction stoichiometry gives one mole of product per mole of reactant. Reactions in which one mole of reactant does not stoichiometrically produce one mole of product must be corrected for this behavior. The correction consists of calculating, in any desired units, the amount of product stoichiometrically obtainable from one unit of reactant. For example, if two pounds of reference reactant combine stoichiometrically with one pound of other reactants, the correction factor would be 3/2, or 1.5. Another example would be a reaction where two moles of product can stoichiometrically be obtained from one mole of reactant; here the correction factor is 2.0. This correction factor, $M_{j/i}$, when multiplied

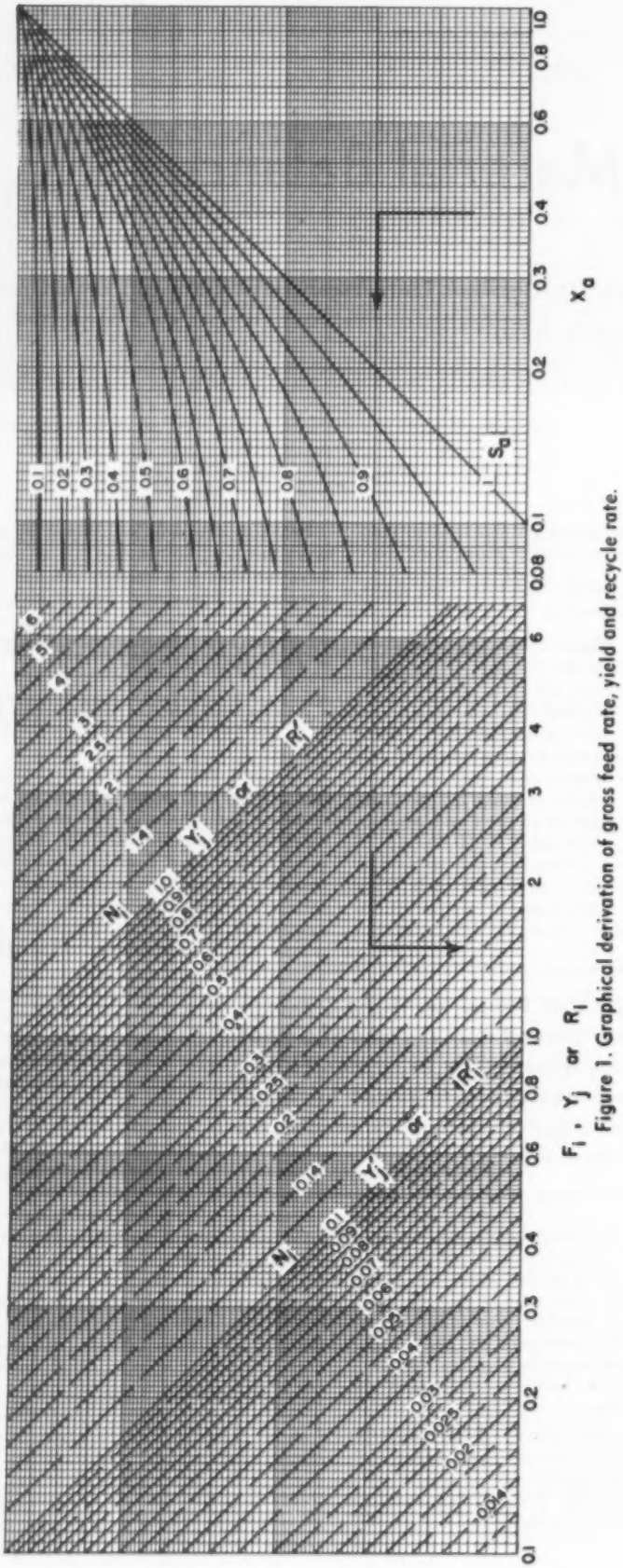

Figure 1. Graphical derivation of gross feed rate, yield and recycle rate.

Recycle Process Material Balance . . .

by the product of conversion, X_i, and efficiency, $E_{j/i}$, will evolve the once-through yield:

$$Y'_j = (X_i)\,(E_{j/i})\,(M_{j/i}) \qquad (1a)$$

It should be noted that the once-through yield calculated by (1a) will be in the same units as the correction factor.

Transposing these single-pass results to a recycle operation presents no difficulties so long as all of the unconverted reactant can be recovered for recycle. Mathematically, the yield with such recycle, or ultimate yield, would be:

$$Y_j = Y'_j/X_a \qquad (2)$$

Complete recovery of unconverted reactant in a process is seldom possible. However, if another term—the recovery of the reactant, S_a,—is introduced, the ultimate yield can again be calculated:

$$Y_j = \frac{Y'_j}{1-(1-X_a)\,(S_a)} \qquad (3)$$

It can be seen that if complete recovery of the reactant is obtainable, then Expression (3) becomes identical to Expression (2).

These first three expressions supply answers to the question, "What will the process do?" This question is probably the one most commonly requiring an answer. The process engineer often must go further in designing equipment and obtain an answer to the question, "What size equipment does the process require?" The once-through data may also be used to provide this answer. On the basis that ratios among the reactants in the gross feed will be the same in recycle operation as in the single-pass experiment, the gross feed rate of any given reactant will be:

$$F_i = \frac{N_i}{1-(1-X_a)\,(S_a)} \qquad (4)$$

The gross feed rate to the reactor will be the sum of the feed rates of the individual reactants, each calculated by (4). This gross feed rate will be in terms of the fresh feed rate of the selected key reactant.

The ratios among recycle reactant streams will usually differ from the gross feed ratios required for the duplication of the once-through conditions. This is a consequence of the different conversions on the individual reactants and the various efficiencies with which the unconverted reactants may be recovered. Again in terms of unit fresh feed rate of the key reactant, the recycle rate for any reactant will be:

$$Ri = \frac{(N_i)\,(1-X_i)\,(S_i)}{1-(1-X_a)\,(S_a)} \qquad (5)$$

The only quantities remaining to be calculated to complete the material

"The mathematical relationships of conversion, efficiency and yield to each other depend on the definitions of these terms."

balance are the rates at which the reactants other than the key reactant must be supplied as fresh feed. Having calculated the gross feed rate and recycle for each reactant by means of Expressions (4) and (5) respectively, the fresh feed rate for any reactant will be simply:

$$Q_i = F_i - R_i \qquad (6)$$

All of these relations are based upon streams entering and leaving the reactor. While yield and efficiency are often used to describe the output of a process where the effect of imperfect product recovery is included, the yield and efficiency terms used here are based on the composition of the reactor effluent. A method of correcting this yield for imperfect product recovery will be described later in this paper.

Expressions 1 to 6 are adequate for the needs of those who do not have a great many of the calculations to make. Others who find themselves repeating the calculations quite often will find that graphical expressions of the mathematical relationships are useful. Figures 1 and 2 are the graphs required. The suggested procedure for using the graphs is as follows:

1. Write the equation for the chemical reaction, showing the amount of each component in the reactor influent and effluent as observed from the results of the once-through experiment.
2. Select one of the reactants to be the key reactant.
3. Divide the observed once-through material balance by the amount of key reactant to get the results on the basis of unit key reactant.
4. Calculate the conversion for each reactant, X_i.
5. Calculate or estimate the fraction of each reactant which can be recovered from the reactor effluent for recycle, S_i.
6. Observe N_i and Y'_j from above Step 3.
7. To get yield, Y_j, of product j from the recycle operation, go through X_a, S_a and Y'_j as indicated on Figure 1.
8. To get the gross feed rate, F_i, of reactant i in the recycle operation, go through X_a, S_a, and N_i as indicated on Figure 1.
9. To get the recycle rate, R_i, of reactant i:

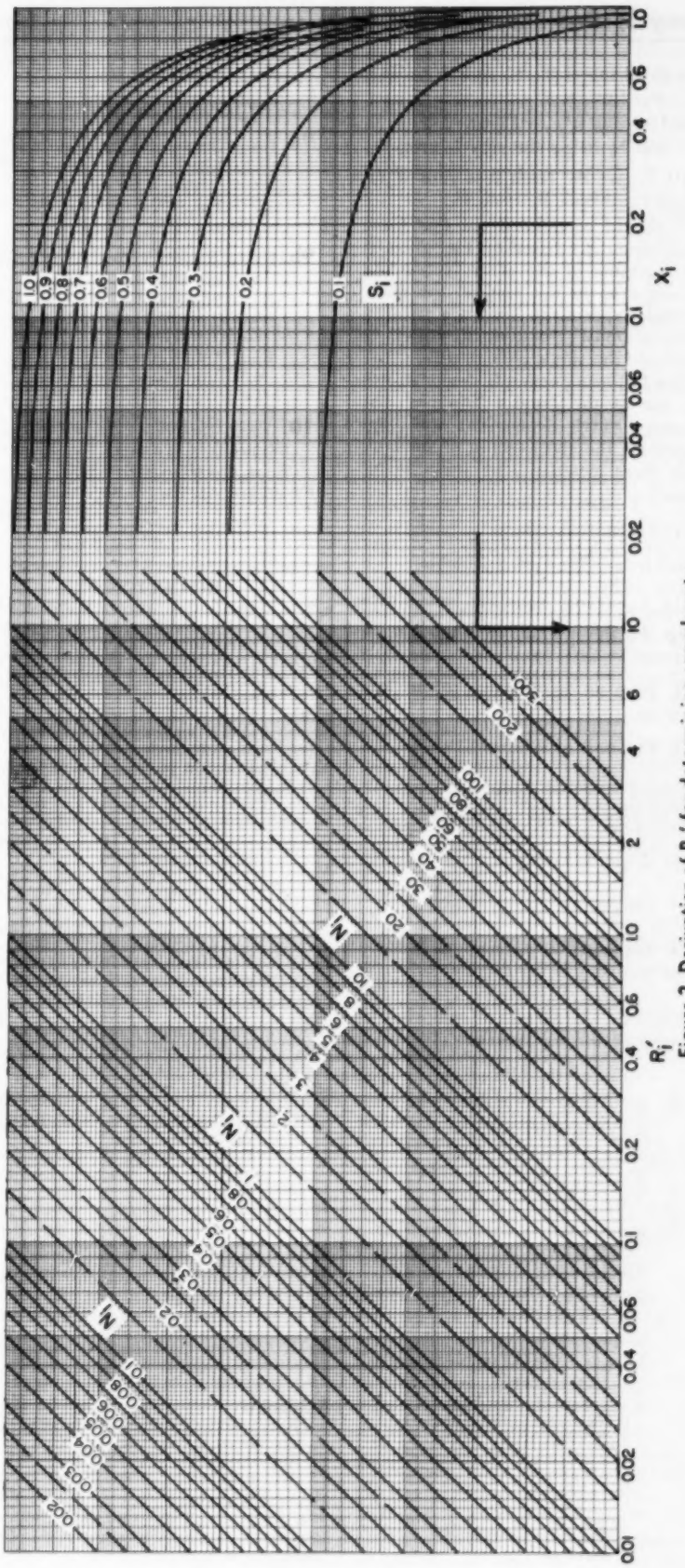

Figure 2. Derivation of R_i' for determining recycle rate.

a. Go through X_1, S_1 and N_1 on Figure 2 to get R'_1.

b. Use this R'_1 on Figure 1 with X_a and S_a to get the recycle rate, R_1.

10. To get the fresh feed rate of reactant *i*, subtract R_i from F_i.

It should be pointed out that these calculations are based on the ratios of the reactants in the gross feed being the same as in the feed to the once-through experiment. This is a requirement of most reactions in order to duplicate the single-pass results.

The following example demonstrates the use of the graphs. Suppose that a once-through experiment was conducted on the chlorination of benzene with these results, the units being pounds:

$$117.0\ C_6H_6 + 95.9\ Cl_2 \rightarrow 67.5\ C_6H_5Cl + 33.2\ C_6H_4Cl_2 + 38.3\ HCl + 52.6\ C_6H_6 + 21.3\ Cl_2$$

This reaction equation constitutes **Step 1**; the remaining steps are as follows:

2. Benzene is selected to be key reactant.

3. Per unit of key reactant,

$$C_6H_6 + 0.820\ Cl_2 \rightarrow 0.577\ C_6H_5Cl + 0.284\ C_6H_4Cl_2 + 0.327\ HCl + 0.450\ C_6H_6 + 0.182\ Cl_2$$

4. $X_{C_6H_6} = X_a = \dfrac{1 - 0.450}{1} = 0.550$

$$X_{Cl_2} = \frac{0.820 - 0.182}{0.820} = 0.778$$

5. Estimate 90 percent of benzene to be recoverable for recycle,

$$S_a = 0.9.$$

Estimate 80 percent of chlorine to be recoverable for recycle,

$$S_{Cl_2} = 0.8.$$

6. $N_{C_6H_6} = N_a = 1/1 = 1$
$N_{Cl_2} = 0.820/1 = 0.820$
$Y'_{C_6H_5Cl} = 0.577/1 = 0.577$
$Y'_{C_6H_4Cl_2} = 0.284/1 = 0.284$
$Y'_{HCl} = 0.327/1 = 0.327$

7. From Figure 1, for $X_a = 0.550$, $S_a = 0.9$ and —
$Y'_{C_6H_5Cl} = 0.577$, read
$Y_{C_6H_5Cl} = 0.970$ pounds per pound C_6H_6 fresh feed
$Y'_{C_6H_4Cl_2} = 0.284$, read
$Y_{C_6H_4Cl_2} = 0.478$ pounds per pound C_6H_6 fresh feed
$Y'_{HCl} = 0.327$, read $Y_{HCl} =$ 0.548 pounds per pound C_6H_6 fresh feed

8. From Figure 1, for $X_a = 0.550$, $S_a = 0.9$ and —
$N_{C_6H_6} = 1$, read $F_{C_6H_6} =$ 1.68 pounds per pound C_6H_6 fresh feed
$N_{Cl_2} = 0.820$, read $F_{Cl_2} =$ 1.38 pounds per pound C_6H_6 fresh feed

9a. From Figure 2, for $X_a = 0.550$, $S_a = 0.9$ and $N_a = 1$, read $R'_a = 0.408$
From Figure 2, for $X_{Cl_2} = 0.778$, $S_{Cl_2} = 0.8$ and $N_{Cl_2} = 0.820$, read $R'_{Cl_2} = 0.147$

9b. From Figure 1, for $X_a = 0.550$, $S_a = 0.9$ and —
$R'_a = 0.408$, read $R_a =$ 0.680 pounds per pound C_6H_6 fresh feed
$R'_{Cl_2} = 0.147$, read $R_{Cl_2} =$ 0.245 pounds per pound C_6H_6 fresh feed

10. Fresh feed rate $C_6H_6 = 1$ by definition (Note as a check that $F_{C_6H_6} - R_{C_6H_6} = 1.68 - 0.68 = 1.00$)
Fresh feed rate $Cl_2 = 1.38 - 0.245 = 1.135$ pounds per pound C_6H_6 fresh feed

NOTATION

a, b, c	Quantities of reactants A, B and C fed to the once-through operation.
t, u, v	Quantities of products T, U and V made in the once-through operation.
a', b', c'	Quantities of reactants A, B and C appearing in effluent of once-through reactor.
X_i	Fraction of given reactant converted.
Y'_j	Amount of product *j* in reactor effluent per unit of key reactant in fresh feed to once-through operation.
Y_j	Yield of product *j* per unit of key reactant in fresh feed of recycle operation.
S_i	Fraction of unconverted reactant *i* recycled.
S_j	Fraction of product *j* in reactor effluent returned to reactor as part of recycle streams.
$E_{j/i}$	Observed efficiency of obtaining product *j* from reactant *i*.
$M_{j/i}$	Ratio of units of product *j* stoichiometrically obtainable from a unit of reactant *i*.
N_i	Ratio of reactant *i* to key reactant in feed to once-through operation.
Q_i	Fresh feed rate of reactant *i* per unit of key reactant in fresh feed.
R'_i	An intermediate number.
R_i	Recycle rate of reactant *i* per unit of key reactant in fresh feed.
R_j	Amount of product *j* returned to reactor as part of recycle streams per unit of key reactant in fresh feed.
F_i	Gross feed rate of reactant *i* per unit of key reactant in fresh feed.

Subscripts:

a Key reactant—may be any one of reactants
i Any reactant
j Any product

General Reaction:

$$aA + bB + cC + \cdots i \rightarrow tT + uU + vV + \cdots j \cdots + a'A + b'B + c'C + \cdots$$

The same numbers, of course, could have been calculated by substituting the appropriate, X_i, S_i, N_i or Y_j into Expressions 1 to 6.

The discussion to this point has been concerned with processes in which the product in the reactor effluent is completely recoverable. Such processes are exceptional. Three things can happen to product in the effluent: (1) some of it is removed as the product stream; (2) another portion may be returned to the reactor included in reactant recycle streams; and (3) a portion of the product is usually lost to the sewer, atmosphere, etc. The effect of these conditions on over-all process yield can be handled provided that any product recycled to the reactor does not decompose.

The product appearing in the reactor effluent is there from two sources: that made in the reactor and that reaching the reactor effluent by having been recycled. The first step is to calculate the amount of product made by the methods already described where product recovery was not considered. The next step is to determine what fraction of the product appearing in the effluent can be recovered. Third, the fraction of the product which will be recycled to the reactor is estimated or calculated. Having established these relationships, a material balance is set up for the product:

$$(Y_j + R_j)(S_j) = R_j \qquad (7)$$

To illustrate this procedure, suppose that the once-through reaction was the chlorination previously described. The monochlorobenzene made in the recycle operation is 0.970 pounds per pound of benzene in the fresh feed. It is estimated that 85 percent of the monochlorobenzene in the reactor effluent can be recovered and sent to storage. The monochlorobenzene which will be returned to the reactor included in the benzene recycle is estimated to be 10 percent of that in the reactor effluent. The other five percent is lost. Then by Expression (7),

$$(0.970 + R_{C_6H_5Cl})(0.10) = R_{C_6H_5Cl}$$

from which $R_{C_6H_5Cl} = 0.108$ pounds per pound of benzene in the fresh feed.

The total chlorobenzene in the reactor effluent will be 0.970 plus 0.108 or 1.078 pounds per pound of benzene in the fresh feed. When 85 percent of this is recovered, the over-all yield will be 0.916 pounds per pound of benzene in the fresh feed.

ACKNOWLEDGMENT

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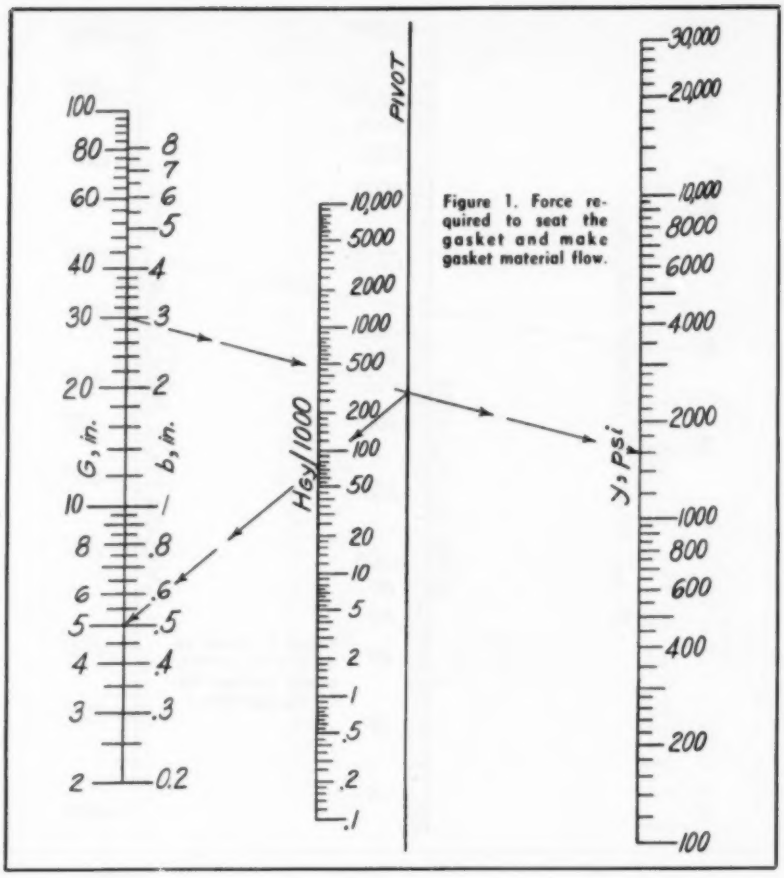


Figure 1. Force required to seat the gasket and make gasket material flow.

How to use . . .

Chart Solutions In Flange Designs

These seven charts greatly speed the computation of flange design problems with little sacrifice in accuracy.

Louis J. Murphy,
International Engineering Associates,
Hicksville, N. Y.

TABULAR solutions of flange design problems have had widespread use in the petroleum industry since the late 30's. A number of flange manufacturers have simplified the work of design engineers by preparing standard tabular forms containing all the necessary equations required for the solution of usual design problems. Well-known and extremely accurate, these forms have the approval of flange builders, design engineers and various regulatory bodies and codes. Though there are slight differences in the forms published by various firms, the results obtained are essentially the same.

Basis of Charts—The seven charts presented in this series are based on the same codes and rules as the tabular solutions discussed above. These charts do not replace the tabular forms—instead they make the use of the forms easier, faster and simpler. Long experience with these charts in the design office and fabrication shop show they eliminate much of the slide-rule drudgery resulting from the necessity of handling large numbers, their squares, square roots, and other functions.

The principal codes governing the design of flanges for pressure vessels in the petroleum industry include the API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases, the ASME Boiler Code, the ASME Unfired Pressure Vessel Code, American Standard (ASA B16e) for Steel Pipe Flanges and Flanged Fittings, and the ASA Code for Pressure Piping. These codes cover such items as materials, gaskets, marking and design practices, allowable stresses, and other important factors in the design, fabrication and application of flanges to unfired pressure vessels of many types.

Chart Applications—For petroleum, petrochemical and related applications, tabular forms are used when designing flanges for heat exchangers of all types—condensers, reboilers, towers, evaporators, etc.—in all pressure and temperature ranges. Tabular solutions of design problems are particularly useful for large-diameter flanges of all types, for special flanges and for unusual piping jobs. These solutions are normally satisfactory for welding-neck, slip-on and lap-joint flanges.

The design charts presented here have the same broad scope as the tabular solutions and, being based on the same codes and rules, help to make the design job easier. They are also excellent for quick checks of computations. Designers using the charts say they have another advantage that pays big dividends—the location of the decimal point is obvious in a chart solution, whereas with a slide rule the decimal point must be located by application of memorized rules. This can lead to errors, especially when large numbers and their squares or square roots are being handled.

Scope of Coverage—The charts in this series cover gasket and bolting calculations, flange loads during operation, and certain shape constants. Values plotted in the charts cover all the usual ranges met in the petroleum industry today. Results are as accurate as with a standard 10-inch slide rule. In some cases they are more accurate. The charts may be used wherever tabular solutions are satisfactory. As was stated earlier, they are used in conjunction with tabular solutions, and do not replace them. Instead they serve

as a handy and permanent means of making tabular design of flanges easier.

Design of a flange may be from any one of three different aspects: (1) development of a flange suitable for a given pressure vessel operating at a known temperature and pressure, (2) completion of a design in which one or more of a number of factors are fixed by conditions surrounding the flange and related to it, and (3) checking an existing flange or design to see if it complies with code requirements or is suitable for new operating conditions.

Factors usually known at the start of flange design include material required, operating temperature and pressure, size of vessel or pipe being considered, and any physical limitations of the installation that may influence the final size of the flange. Typical variables that must be fixed by calculation or study of the operating conditions include selection of the gasket material, choice of a suitable joint, specification of required hub proportions, bolting and flange facing.

Gasket and Bolting Calculations — Our first chart, Figure 1, solves the relation for the force required to seat the gasket and make the gasket material flow. This flow deforms the gasket, causing it to seal itself into the small surface variations always present in a flange facing. Seating of the gasket must be complete before pressure can be applied to the vessel, so the seating force is applied at the atmospheric temperature existing at the time of installation.

Retaining the usual symbols used in flange analysis, the gasket seating force is given by:

$$H_{oy} = \pi(bGy)$$

where H_{oy} = gasket seating force, pounds; $\pi = 3.1416$; b = effective seating width, inches; G = diameter at location of gasket load reaction, inches; y = gasket unit seating load, psi.

Example: What is the gasket seating force in a flange having a diameter of 30 inches at the location of gasket load reaction, an effective seating width of ½ inch, and a unit seating load of 1600 psi?

Solution: Enter the chart on the left at G = 30 inches and draw a straight line through y = 1600 psi on the right. Then from the intersection with the pivot draw a second line through b = ½ inch on the left. Read H_{oy} = 75,200 pounds on the second scale from the left.

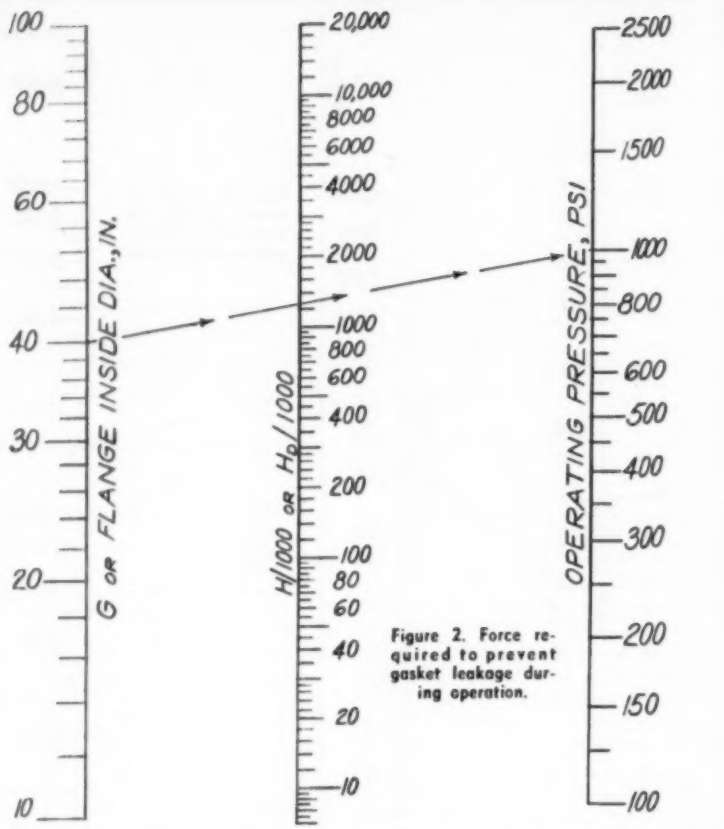


Figure 2. Force required to prevent gasket leakage during operation.

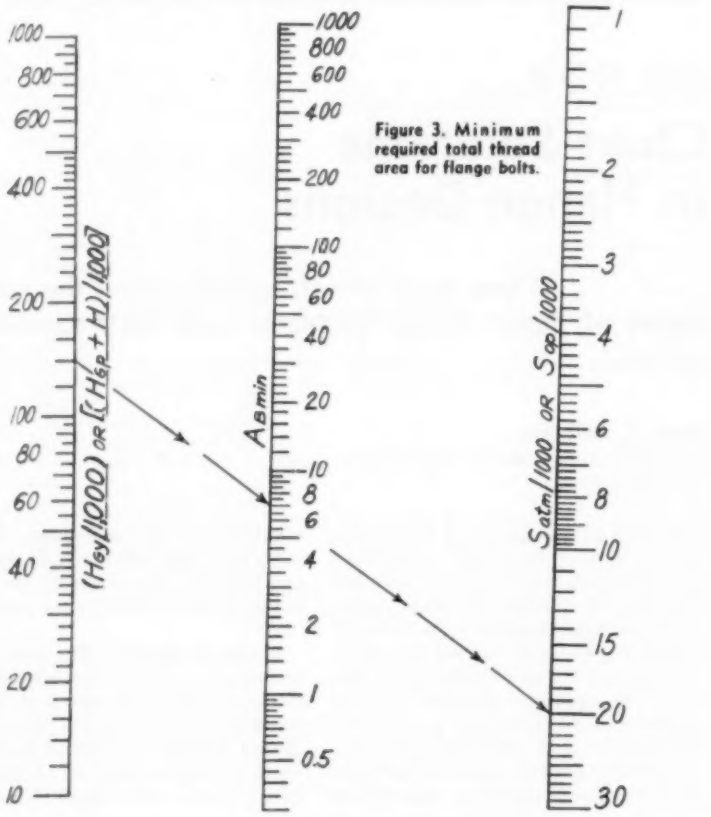


Figure 3. Minimum required total thread area for flange bolts.

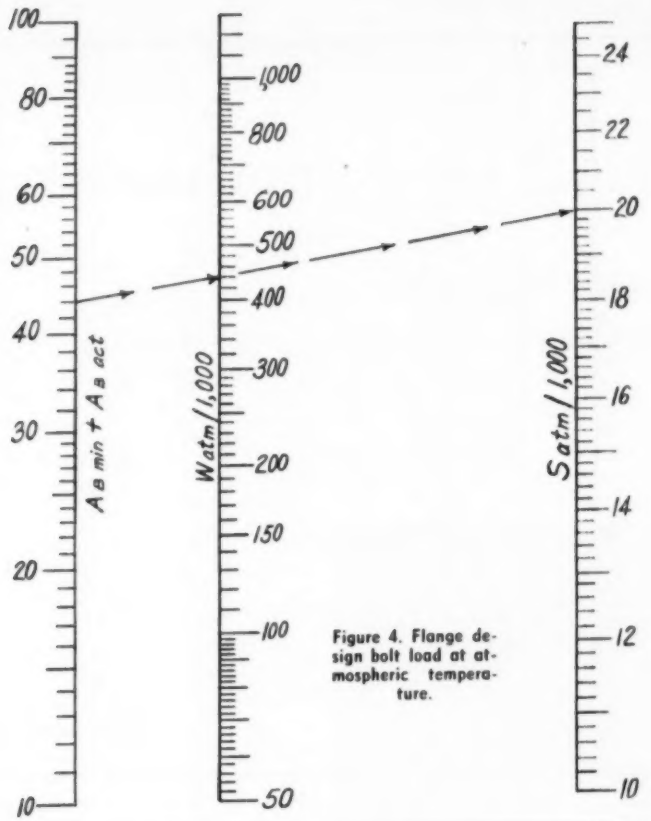


Figure 4. Flange design bolt load at atmospheric temperature.

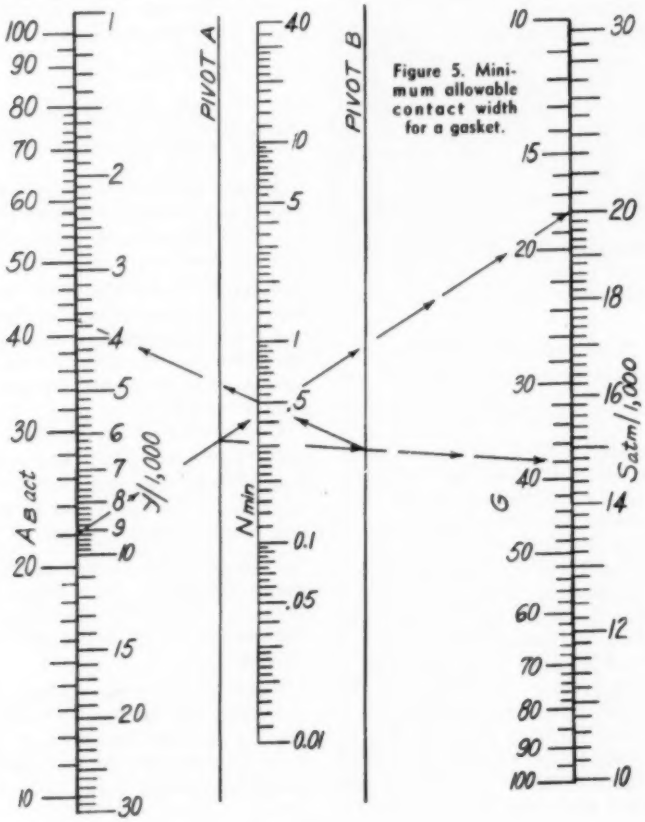


Figure 5. Minimum allowable contact width for a gasket.

H_{Gy} can be a critical factor when the flange is large in diameter, the operating pressure is low and special bolting or gasketing is required. When this occurs, flange proportions may be a function of bolting instead of the internal pressure of the vessel.

Leakage During Operation—To determine the force required on the gasket to prevent leakage during operation of the flange, the following relation is used:

$$H = G^2\pi p/4$$

where H = force needed on gasket to prevent leakage, pounds; $\pi = 3.1416$; p = maximum allowable working pressure, psi; other symbols are the same as before.

Example: What force is needed on a gasket to prevent leakage if G = 40 inches and p = 1000 psi?

Solution: Enter the chart (Figure 2) on the left at G = 40 inches and draw a straight line through p = 1000 psi on the right. At the intersection with the central scale read the total force required as 1,260,000 pounds.

This chart may also be used for flange loads during operation by applying the relation:

$$H_D = B^2\pi p/4$$

where H_D = hub force during operation, pounds; B = inside diameter of flange, inches; other symbols are the same as before.

The problem is solved in the same manner as described for H, except that the inside diameter of the flange is used when entering the chart.

Bolting Area—The minimum total required cross sectional area at the thread roots of the flange bolts can be determined next by the chart in Figure 3. This area is a function of the larger of two values: (1) gasket seating force at installation temperature, H_{Gy} divided by the maximum allowable bolt stress at atmospheric temperature, or (2) the sum of the total gasket pressure load, H_{Gp}, and the gasket force to prevent leakage, H, divided by the maximum allowable bolt stress at operating temperature. The relation for computing the minimum allowable total root area is:

$$A_{Bmin} = H_{Gy}/S_{atm}, \text{ or } (H_{Gp} + H)/S_{op}$$

where A_{Bmin} = minimum required total thread area for flange bolts, square inches; S_{atm} = maximum allowable bolt stress at atmospheric temperature, psi; S_{op} = maximum allowable bolt stress at flange operating temperature, psi. Other symbols are as defined earlier.

Example: H_{Gy} = 140,000 pounds for a given flange. What is A_{Bmin} for this installation if S_{atm} = 20,000 psi

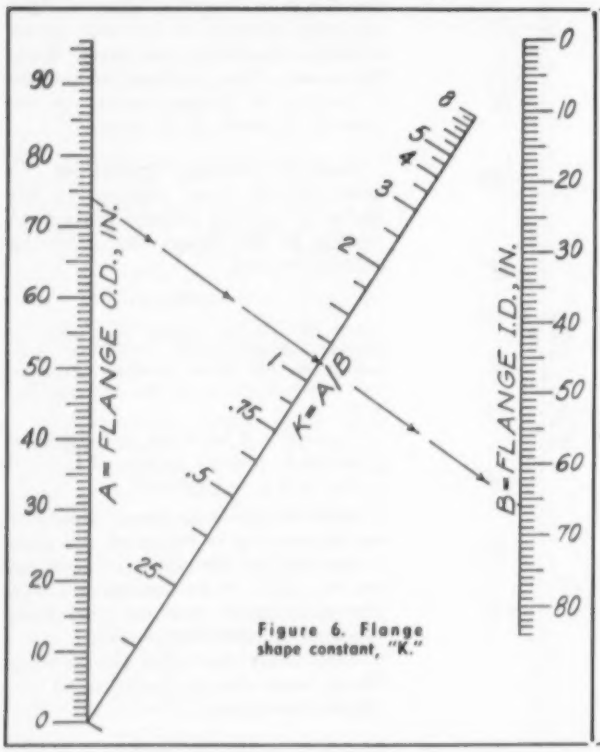


Figure 6. Flange shape constant, "K."

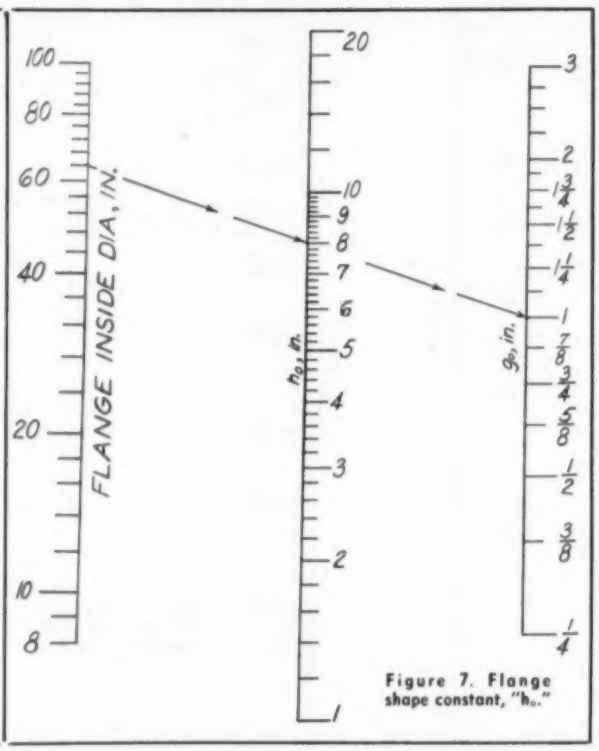


Figure 7. Flange shape constant, "h_o."

and $H_{oy} + H$ is less than 140,000 pounds?

Solution: Enter the chart on the left at $H_{oy} = 140{,}000$ pounds and draw a straight line through $S_{atm} = 20{,}000$ psi on the right. At the intersection with the central scale read the minimum total thread area as 7 square inches. Note that this value is the least area that can be used, and is equal to the product of the number of bolts and the root area of one bolt. Of course, the minimum area can be exceeded, if desired.

Once the actual bolt area is known, the flange design bolt load at atmospheric (installation) temperature without internal pressure can be determined with our next chart, Figure 4. The relation giving atmospheric bolt load for the flange is:

$$W_{atm} = 0.5(A_{Bmin} + A_{Bact})S_{atm}$$

where W_{atm} = bolt load on flange at atmospheric temperature, pounds; A_{Bmin} = minimum bolt area required, square inches (from previous chart); A_{Bact} = actual total cross sectional root area of the bolts, square inches (equal to or greater than A_{Bmin}); other symbols as before.

Example: What is the actual atmospheric-temperature bolt load for a flange when minimum allowable area is 21 square inches, and actual area used is 23 square inches, if allowable bolt stress at atmospheric temperature is 20,000 psi?

Solution: Sum of the minimum and actual areas is $21 + 23 = 44$ square inches. Enter the chart on the left at this value and draw a straight line through the allowable stress of 20,000 psi on the right. At the intersection with the central scale read the atmospheric bolt load as 440,000 pounds.

Gasket Contact Width—We are now ready to determine the minimum allowable contact width of the gasket from:

$$N_{min} = (A_{Bact}S_{atm})/2\pi yG$$

where N_{min} = minimum allowable contact width of the gasket, inches; other symbols as before. See Figure 5.

Example: What is the minimum allowable contact width for a gasket when $A_{Bact} = 22$ square inches, $S_{atm} = 20{,}000$ psi, $G = 38$ inches, and $y = 3700$ psi?

Solution: Enter the chart on the left at 22 square inches and draw a straight line through 20,000 psi on the right. Then, from the intersection of this line with Pivot A, draw a second straight line through $G = 38$ inches on the right. Lastly, from the intersection of the second line with Pivot B, draw a third straight line through $y = 3700$ psi on the left. At the intersection with the central stem read $N_{min} = 0.5$ inch.

Shape Constants—The first shape constant we can compute with these charts is K, expressed as:

$$K = A/B$$

where K = a flange shape constant; A = outside diameter of flange, inches; B = inside diameter of flange, inches.

Example: What is the value of K for a flange having an outside diameter of 74 inches, and an inside diameter of 66 inches?

Solution: Enter the chart shown in Figure 6 on the left at $A = 74$ inches, and draw a straight line through $B = 66$ inches on the right. At the intersection with the central sloping scale read $K = 1.12$.

Our second shape constant is h_o, given by: $h_o = \sqrt{Bg_o}$, where h_o = a flange shape constant, inches; g_o = thickness of the flange hub at its small end, inches; other symbols as before.

Example: What is the value of the shape constant h_o for a flange having an inside diameter of 64 inches and a thickness of 1 inch at the small end of the hub?

Solution: Enter the chart in Figure 7 on the left at $B = 64$ inches and draw a straight line through $g_o = 1$ inch, on the right. At the intersection with the central scale, read $h_o = 8$ inches.

Here's latest information on . . .

Hydrocarbons from Cellulosic Wastes

Part I. Conversion methods and the effect of lignin on the conversion.

Part II. The nature of the synthetic products.

Heinz Heinemann,
Marcus Hook, Pa.

EARLIER ARTICLES in this series[1,2] have discussed the conversion of sugar cane to hydrocarbons and the effect of lignin on carbohydrate to hydrocarbon conversion. Only limited data have so far been given on the characteristics of the various synthetic petroleum fractions.

The current article tries to fill this gap. In view of the fact that all conversions were carried out in relatively small laboratory equipment, it will be understood that the quantities of hydrocarbon fractions available were relatively limited, even though they were accumulated over a considerable number of conversion runs. It was, therefore, not possible to obtain all the data which seemed important. The information gained and reported here, however, demonstrates the striking similarity between crude oil fractions and the synthetic products obtained from cellulosic material.

The methods used for conversion of carbohydrates to hydrocarbons were the same as have been described before.[1,2] The raw materials used were sugar cane and bamboo sticks. Digestion of the raw material was carried out with 1-N sodium hydroxide at 650 or 850 F. in a bomb. Bituminous material recovered from the product was hydrogenated in the bomb at 750 F. and 1000 psig over molybdenum sulfide catalyst. Hydrogenated bitumen was extracted with carbon tetrachloride and the extract was subjected to fractional distillation to yield (1) gasoline (400 F. end point) (2) naphtha (400-500 F.), (3) gas oil (500-700 F.), (4) lubricating oil from vacuum distillation and (5) an asphaltic residue. These five fractions are more closely described in the following.

Note—Dr. Heinemann currently is connected with Houdry Process Corporation.

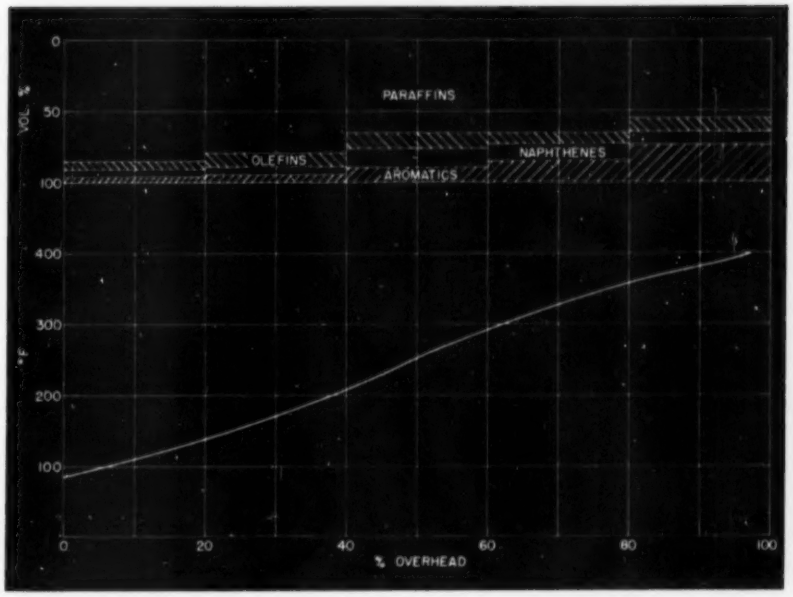


Figure 1. Gasoline from sugar cane. Digestion temperature 650 F.

Analytical Methods—Methods used for the identification and characterization of the various fractions were conventional. Distillation of gasoline followed ASTM procedure[3] and type analysis was according to the method of Faragher, Morrell and Levine.[4] Sulfur (lamp method), color, flash point and aniline points were measured in accordance with standard practice.[5] The determination of aromatic and naphthenic rings and paraffinic side chains in heavier molecules followed the ideas advanced by Vlugter, Waterman and vanWesten[6] and using the method of calculation without hydrogenation which is well described by A. N. Sachanen.[7] Carbon and hydrogen analyses were by semi-micro combustion.[8]

Results and Discussion

Gasoline—Three gasolines were investigated. Two were derived from sugar cane and one from bamboo sticks. One of the products from sugar cane was digested at 800 rather than 650 F. The following table gives the yields, based on dry raw material, in which these fractions were obtained:

Gasoline from sugar cane: 650 F. digestion, 3.0 weight percent.
Gasoline from sugar cane: 800 F. digestion, 3.8 weight percent.
Gasoline from bamboo sticks: 650 F. digestion, 4.0 weight percent.

Distillation and inspection data for these gasolines are presented in Table 1, while Table 2 compares the product

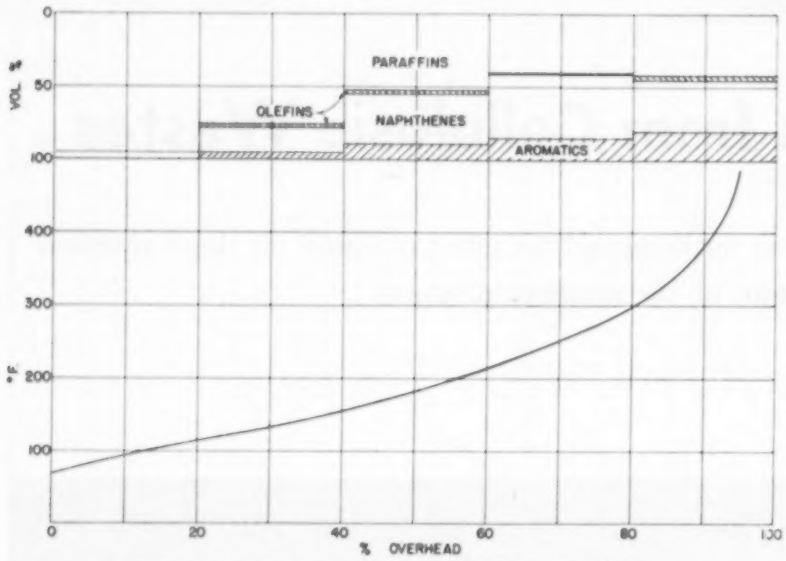


Figure 2. Gasoline from sugar cane. Digestion temperature 800 F.

distribution by hydrocarbon type. Figures 1-3 show the hydrocarbon type distribution for various boiling ranges.

Comparison of the two gasolines from sugar cane shows prevalence of lower boiling components and the much more saturated character of the product obtained at higher digestion temperature. (Less olefins and aromatics, more naphthenes.) Since both products have gone through a hydrogenation step in which hydrogenation was carried out until there was no more hydrogen consumption, it is quite possible that the higher digestion temperature causes destruction of some compounds which, when present, are catalyst deactivators during the hydrogenation step. In addition, some cracking to lighter products may occur during digestion at the higher temperature.

Inspection of the hydrocarbon type distribution over different boiling ranges (Figures 1-3) reveals the predominantly paraffinic character of the lower boiling components and the gradual increase with boiling range in the amount of aromatics present. Some benzene and toluene appear to be formed along with higher boiling aromatics. An attempt to better resolve the nature of the paraffinic-naphthenic fraction by silica gel separation and fractionation of the saturates failed to give the desired information and no infrared spectrograph was available for compound identification. A separation of normal and isoparaffins by urea adduct formation would probably also result in interesting information.

While there are differences between the gasolines described in Table 1 and 2, they all fall well within the range of characteristics of many gasolines from crude petroleum and, except for the presence of a small amount of olefins which are probably the product of some cracking or incomplete destructive hydrogenation, they resemble typical straight run gasolines. While gasolines from only two raw materials, worked up at one set of operating conditions do not offer enough data for a strict comparison, it would appear that other cellulosic materials can also be processed to yield gasolines similar to straight run petroleum gasolines. The question of whether and how differences in the composition of the raw material affect the nature of the products might be well worth investigation.

There seems little doubt that these gasolines could be upgraded by catalytic reforming. Since all of the work reported here was done before the advent of the new catalytic reforming processes, the only reforming data available are those previously published.[1] These indicate, however, that gasolines from cellulosic materials lend themselves to normal refining and upgrading techniques just as well as straight run gasolines of similar composition.

Naphtha—Kerosine fractions (400-500 F.) were recovered in these yields, based on dry raw material:

From sugar cane, digested at 650 F.: 4.9 weight percent.
From sugar cane, digested at 800 F.: 5.3 weight percent.
From bamboo sticks, digested at 650 F.: 5.1 weight percent.

Inspection data on these naphthas are presented in Table 3 and very little if any differences are apparent between them. Again, they resemble closely similar inspection data for virgin naphthas of this boiling range, except for the lower gravity and aromatics content which are no doubt due to the fact that these synthetic hydrocarbons have undergone a hydrogenation step and are, therefore, predominantly naphthenic-paraffinic.

Gas Oil—Gas oil fractions, boiling between 500-700 F. were obtained in these yields, based on dry raw material:

From sugar cane, digested at 650 F.: 20.8 weight percent.

TABLE 1

Characteristics of Synthetic Gasolines

	Gasoline From Sugar Cane		Gasoline From Bamboo Sticks
Gasoline Number	1	2	3
Temp. of Digestion, °F.	650	800	650
Gravity, °API	63.1	60.0	57.2
I. B. P., °F.	90	75	70
10 Percent	105	90	90
20 Percent	133	109	121
30 Percent	170	130	165
40 Percent	206	153	203
50 Percent	254	182	230
60 Percent	291	212	248
70 Percent	322	251	270
80 Percent	352	302	301
90 Percent	378	376	348
End Point	401	433	403
Sulfur, Percent	0.003	0.001	0.001
Octane No., F-2	35	48	40
Color, Saybolt	30+	29	29

TABLE 2

Hydrocarbon Type Analysis of Gasolines

	PERCENT											
	Paraffins			Olefins			Naphthenes			Aromatics		
Gasoline No.	1[a]	2[b]	3[c]	1[a]	2[b]	3[c]	1[a]	2[b]	3[c]	1[a]	2[b]	3[c]
Volume Percent—1–20	85	95	85	6	0	10	5	5	0	4	0	5
21–40	80	76	76	9	1	8	7	19	9	4	4	7
41–60	65	52	59	12	1	7	14	35	19	9	12	15
61–80	65	40	48	9	0	5	10	45	27	16	15	20
81–End	55	42	48	9	1	5	9	37	22	27	20	25
Total	70	61	63	9	1	7	9	28	15	12	10	14

[a] Gasoline 1: From sugar cane at 650 F. digestion.
[b] Gasoline 2: From sugar cane at 800 F. digestion.
[c] Gasoline 3: From bamboo sticks at 650 F. digestion.

From sugar cane, digested at 800 F.: 21.3 weight percent.
From bamboo sticks, digested at 650 F.: 21.0 weight percent.

Inspection data were, however, obtained only for the gas oil from sugar cane which had been digested at 800 F. (Table 4). This fraction, like the naphtha, is less aromatic and more naphthenic than one would expect from a straight run gas oil, probably because of the hydrogenation step involved in the conversion of bitumen to synthetic crude. This fact probably contributes to its relatively good cetane number. Data on the catalytic cracking properties of this fraction have been published before[1] and show that it lends itself to conversion to gasoline as well as most straight run gas oils.

Lubricating Oil—The lube oil fractions were obtained by vacuum distillation from the residual hydrocarbons boiling above 700 F. They were viscous, had a greenish-brown fluorescence and contained up to 2 percent oxygen in the case of fractions derived from sugar cane and bamboo sticks by digestion at 650 F. Digestion of sugar cane at 800 F. resulted in an almost oxygen-free lube oil fraction. In order to remove oxygenated compounds, the first two composites were again hydrogenated in the presence of a Raney nickel catalyst. Yields of lube oil fractions, based on dry raw material were:

From sugar cane, digested at 650 F.: 7.4 weight percent.
From sugar cane, digested at 800 F.: 7.2 weight percent.
From bamboo sticks, digested at 650 F.: 6.4 weight percent.

Table 5 gives some inspection data on the hydrogenated fraction from sugar cane. While it must be assumed that most ring compounds present after repeated hydrogenation are naphthenic, the relatively high gravity, low molecular weight and poor viscosity index seem to indicate that ring compounds predominate in this fraction.

Asphalt—Two asphaltic materials are obtained in the course of processing carbohydrates. The first is the raffinate phase from the carbon tetrachloride extraction of the hydrogenated synthetic crude. This comprises about 3.2 percent of sugar cane and 1.6 percent of bamboo sticks, is relatively high in methoxyl content[2] and has not been investigated in detail. The second is the residue from the distillation of the synthetic crude, which amounts to about 10 weight percent of sugar cane and 7 weight percent of bamboo sticks and also contains methoxyl oxygen.[2] This material is very high in resins. Only 16.3 percent of the residue from sugar cane is pentane soluble and 4.7 percent is hexane soluble. The pentane and hexane solubles are almost free of oxygen and the pentane solubles contain 90.3 percent carbon and 9.7 percent hydrogen for a carbon to hydrogen ratio of .78. The total asphaltic fraction has a specific gravity of 1.196, a softening point of 66 C. (151 F.) and contains 90.1 percent carbon, 8.7 percent hydrogen for a carbon to hydrogen ratio of .86. The saturated character of all these materials is apparent in the relatively low carbon/hydrogen ratios. The material is glossy black and completely soluble in carbon tetrachloride and in benzene. In solution it has a greenish fluorescence.

In presenting the data contained in this and earlier articles, it is realized that the available information is sketchy and that much additional work remains to be done to investigate the effect of operating variables and raw material composition on the nature of the synthetic crude and its components. Very little work has apparently been done along the lines of carbohydrate to hydrocarbon conversion since the death of Dr. Ernst Berl in 1946.

Demonstration of the fact that truly petroleum-like hydrocarbons can be synthesized from such an abundant raw material as cellulose, will, it is hoped, stimulate new research in this field.

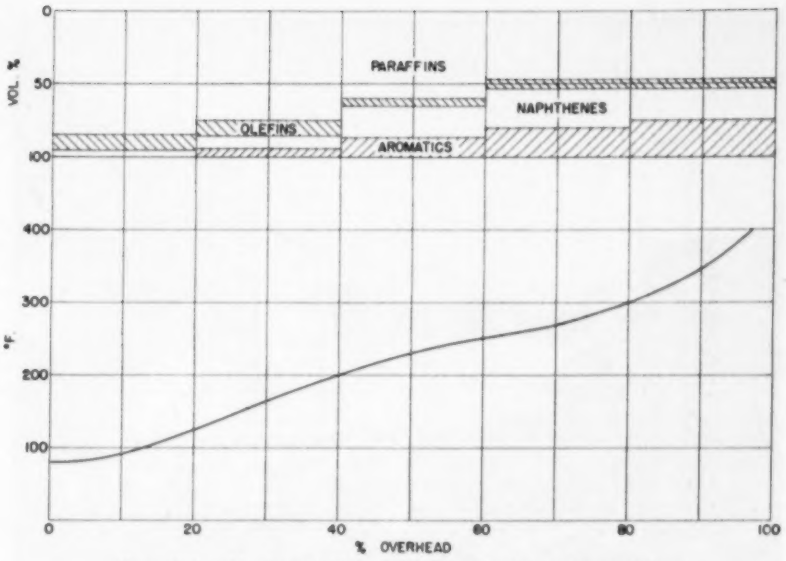


Figure 3. Gasoline from bamboo sticks. Digestion temperature 650 F.

TABLE 3
Characteristics of Synthetic Naphthas
Boiling Range 400-500 F.

	From Sugar Cane		From Bamboo Sticks
Digestion Temp., °F.	650	800	650
Specific Gravity at 15 C	0.768	0.754	0.773
Aromatics, Percent	8	5	7
Sulfur, Percent	0.02	0.01	0.02
Color, Saybolt	26	28	26
Flash, (Tag Closed Cup), °F.	125	130	127
Doctor Test	Sweet	Sweet	Sweet

TABLE 4
Characteristics of Synthetic Gas Oil From Sugar Cane
Boiling Range 500-700 F.

Specific Gravity at 15 C.	0.871
Aniline Point, °C.	79
Cetane No.	43
Molecular Weight	274
Specific Refraction	0.3230
Pour Point, °C.	—37
Carbon, Percent	88.8
Hydrogen, Percent	10.8
Carbon/Hydrogen Ratio	.69
Ring Analysis:	
Aromatic Rings, Percent	9
Naphthenic Rings, Percent	42
Paraffinic Side Chains, Percent	49

TABLE 5
Characteristics of Synthetic Lubricating Oil From Sugar Cane

Molecular Weight	420
Specific Gravity at 15 C.	0.910
Viscosity at 100 F. (S.V.)	2650
Viscosity at 210 F. (S.V.)	85
Viscosity Index	15
Flash, °F.	410
Aniline Point, °C.	97
Refractive Index at 20 C.	1.496
Carbon, Percent	90.4
Hydrogen, Percent	9.6
Carbon/Hydrogen Ratio	.79

REFERENCES

[1] Heinemann, H., PETROLEUM REFINER **29**, 111, (1950).
[2] Heinemann, H., PETROLEUM REFINER **33**, July, 161 (1954).
[3] A.S.T.M. D86-46.
[4] Faragher, W. F., Morrell, J. C. and Levine, I. M., *Ind. Eng. Chem.*, Anal. Ed. **2**, 18 (1930).
[5] Tag Manual for Inspectors of Petroleum, Fischer Scientific Co., Pittsburgh.
[6] Vlugter, J. C., Waterman, H. I. and van Westen, H. A., *J. Inst. Pet. Tech.* **18**, 735 (1932); **21**, 661 (1935); **21**, 701 (1935).
[7] Sachanen, A. N., The Chemical Constituents of Petroleum, Reinhold Publishing Corp., New York 1945.
[8] Heinemann, H., *Oil and Soap*, **23**, 227, (1946).

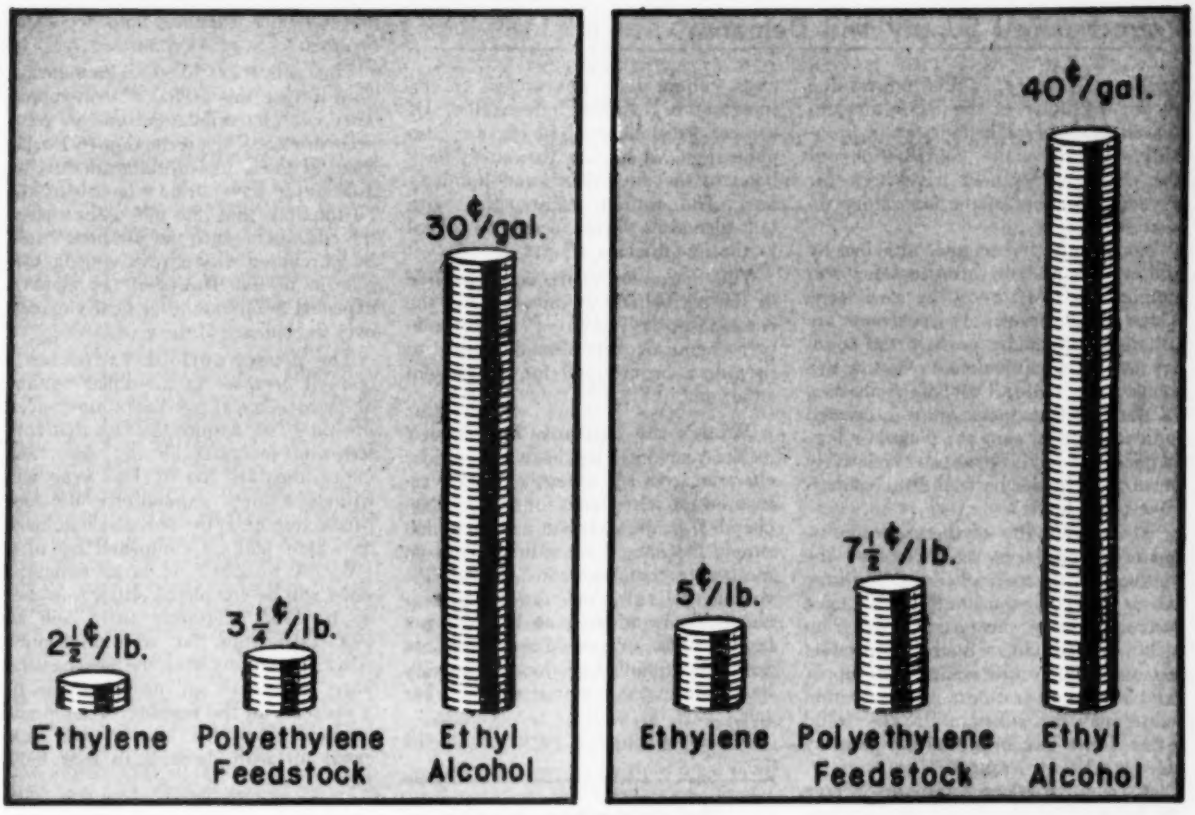
Unusual Training Pit Aids Firemen

THE DOW Chemical Company has set up an unusual training pit at its Midland, Mich., plant as an aid to teaching employes approved methods of fire-fighting. Any plant group may receive training on request. Instruction includes lectures on fire hazards, fire classification, use of visual flammability identification symbols, fire extinguisher mechanics, etc.

Picture 1—Over-all size of the platform is 24 feet by 36 feet (concrete). An area 18 feet by 24 feet is covered by two layers of fire brick to prevent concrete from cracking due to the heat. This area also contains an 8 feet by 10 feet liquid fire pit, 4 inches deep. In this photo firemen are being trained in the use of fog nozzles to control liquid fire under pressure, so that supply of liquid can be shut off.

Picture 2—An incombustible building at one end of the platform contains a 25-gallon tank of gasoline and a cylinder for other flammable liquids. Nitrogen cylinder in foreground is used to pressure either cylinder. Sprinkler head under ceiling is used to demonstrate operation of sprinkler systems.

Picture 3—This picture shows a piping diagram for use on liquid or gas fires under pressure. Valves are so located to allow liquids to flow out of leaky pump gland, or leaky flanges or valves. The relief valve opens when pressure in pipe line is increased due to heat. Students are shown the importance of controlling, rather than extinguishing, such fires in enclosed areas to prevent creation of explosive conditions.



IN A TIGHT MARKET

. . . the integrated producer's costs may look something like this . . . . . while the non-integrated producer may be faced with these costs.

Factors entering into . . .

Petrochemical Supply and Demand

For this, a period of readjustment for the petrochemical industry, here is the picture on the short-range outlook, the effect of integration on competitive positions of producers and an insight into cost appraisal.

R. E. Hulse,
National Distillers Products Company,
New York

OVER THE PAST few years there has been a certain amount of glamour and romance attached by the general public to the word "petrochemicals." In fact, one president of a petroleum company recently stated, off the record, that the chief factor in influencing his entry in the petrochemical field via ammonia was the number of letters from stockholders asking why his company had not entered the field of petrochemicals. However, it is believed that inspection of earning records would indicate that the petroleum industry, with its special tax treatment for depletion, as well as accelerated amortization on physical assets, currently averages a higher return on investment than the petrochemical field. It seems to be of greater advantage for cyclic industries such as textiles, beverage, etc., and regulated industries such as natural gas companies to enter the petrochemical field. An increasing trend in the latter case is expected since it now appears that earnings from petrochemical operations may not be subject to regulation by the Federal Power Commission.

Why the High Interest in Petrochemicals?—The romance attached to petrochemicals by the general public is understandable. Synthetic rubber and plastics which developed so rapidly during the war were tangible evidence of the contributions by the petrochemical industry. However, petrochemicals have just as much ro-

mance to industry. Is this interest due to the ingenuity of the laboratory research chemist? The answer is probably, no, since the contributions of the chemical engineer have been far greater than that of the laboratory research chemist.

Apparently the romance attached by industry is due to three factors: economics, rate of growth, and large scope of operations. Hydrocarbons are obtainable in many parts of the country at prices equivalent to one to two cents per pound. Cost of production of these hydrocarbons in an integrated unit may be ½ cent per pound or less. Where else can versatile, relatively pure feed stocks be found at comparable price levels?

The availability of these cheap raw materials on large scale changed the outlook of the petrochemical industry about 1940. Previous to that date, most petrochemicals were produced from unsaturates in refinery by-product streams which are limited in supply and whose separation and purification costs may be substantial. The trend after 1940 has been to use primary feed stocks, for example

- To crack ethane, propane, butane to form ethylene, propylene, butylene and butadiene.
- To reform or partially oxidize natural gas or hydrocarbons to produce hydrogen for ammonia.
- To oxidize methane to acetylene and higher hydrocarbons to aldehydes, ketones, acids, etc.
- To produce aromatics by reforming certain cuts.

Petrochemicals originally were a means of up-grading by-products. Now petrochemicals are a means of upgrading primary products above fuel or gasoline value.

The second factor contributing to the petrochemical romance is rapid growth resulting from expanding markets. The petrochemical industry cannot claim credit for this except by making available low cost intermediates for synthetic rubber, plastics, etc. Credit for expanding these markets belongs primarily to the rubber, plastic and chemical industries.

The third factor contributing to romance is the large scale of operations of individual plants. Most petrochemical projects cost from 10 to 50 million dollars. Contrast the petrochemical industry with the electrochemical industry. More than one petrochemical project has started off with greater sales and investment than many electrochemicals companies which have been in existence 50 to 100 years.

The initial operation of such large units cannot help but appeal to the imagination of any industrialist. Of course, petrochemical plants are also photogenic which has proved to be a boon to the advertising and publicity men. The outdoor construction with tall, gleaming towers, seems to appeal to the imagination of everyone.

This discussion of the romantic side of the petrochemical industry and the enthusiasm of industry to get into petrochemicals was intended only to provide a background for the present situation.

What's the Outlook This Year?—The year 1954 has been and will be characterized by abnormally low return on the investment for many petrochemical projects. It is a year in which supply has caught up with demand on most petrochemicals. In general, the volume of sales of major petrochemicals is at least as high, if not higher, than in preceding years, but new and expanded productive capacity has made excess material available for sale.

This over-supply is partly due to the effect of accelerated amortization which has provided an incentive for many companies to expand operations, or develop new projects, and partly to the fact that previous high price levels indicated attractive returns on investment for petrochemical projects which overstimulated expansion. Currently it would be difficult to find any major petrochemical in short supply, except where new demands have developed due to changes in technology or new products.

> "The competitive situation in the field of petrochemicals today certainly indicates that successful petrochemical projects must be large scale and thoroughly integrated."

National Petro-Chemical Corporation with 60-percent ownership by National Distillers Products Corporation and 40 percent by Panhandle Pipe Line Company has recently started up a new $50-million petrochemical plant at Tuscola, Ill.

The philosophy of this organization is to sell on long term contract with discount which reflects to the customer the savings resulting from the elimination of sales expenses and technical services.

This policy has lived up to expectations during this period of over-supply since contract sales requirements have been in excess of production so far, as some of the usual mechanical start-up difficulties have been experienced. Fortunately this has not embarrassed the customers since the products could be purchased elsewhere during this interim period. However, the plant is expected to operate at or near capacity over the balance of the year.

The present outlook indicates a marked decrease in the dollar volume of petrochemical projects announced during 1954, despite the fact that construction forecasts do not show any major dip. Of course, this year will witness a large expenditure for new production units for polyethylene, most of which will be completed by mid-1955. A number of large ammonia units will be completed either this year or in 1955. Certainly there will be less justification for additional polyethylene projects over the next several years and there will probably also be a decrease in the number of ammonia projects since the supply will soon catch up with demand in that field, too.

What Are the Advantages of Integration?—The competitive situation in the field of petrochemicals certainly confirms the original conclusion that successful petrochemical projects must be large scale and thoroughly integrated. This is due to the fact that many petrochemical companies charge their feed stocks at cost of production rather than fair market value. This may appear to be false bookkeeping and to a certain extent is. On the other hand, a non-integrated producer does not have this opportunity and so may be at a great disadvantage in a highly competitive market.

A few examples from the field of ethylene chemistry might illustrate this point. It costs approximately $12 million for a 300-ton-per-day ethylene unit producing 96 percent purity ethylene, which includes associated utilities and general investment. Ethylene can be produced on this scale of operation for approximately 2½ to 3 cents per pound and is currently being sold in excess of 4½ cents per pound, according to available information. With a production of 200 million pounds per year, this means a gross profit of $3 to $4 million on a $12 million investment, which is a very satisfactory return.

On the other hand, a smaller producer with a requirement of a hundred tons of ethylene may expect costs of

approximately 4 cents per pound with a unit investment approximately 50 percent higher than that of the 300 ton unit. Obviously, the small consumer cannot justify an ethylene unit. However, this immediately restricts his operations to higher profit items which are most likely to exist in fields in which the market has not become saturated yet, in fields where ethylene costs are only a minor part of the cost of production or in fields where the patent situation prevents or limits competition.

The non-producer of ethylene, however, cannot compete, for example, in the field of bulk chemicals such as industrial alcohol. It takes 4¼ to 4½ pounds of ethylene per gallon of alcohol, with an assumed cost of 5 cents per pound of ethylene delivered to his plant. This means his raw material cost is approximately 22 cents per gallon, with conversion costs of 7 to 10 cents per gallon. To this he must add freight of 5 to 6 cents per gallon, sales expense of 3 to 4 cents per gallon, which means that his costs before overhead and administrative expense will be approximately 40 cents per gallon. This is the current posted market price. His investment per gallon, including associated utilities and general facilities, will be in the range of 30 to 45 cents per annual gallon, which means that he requires a profit of 7 to 15 cents per gallon to achieve the same type of return as a producer of ethylene.

A range of 50-55 cents per gallon is required if the non-integrated producer is to obtain an attractive return on his investment. Thus, the 55 cents ceiling for synthetic alcohol during the war period was not an exhorbitant price level.

On the other hand, the integrated producer, charging his ethylene in at 2½ instead of 5 cents, has an apparent advantage of better than 10 cents per gallon. Admittedly it is false accounting to charge his ethylene in at cost without allowing for return on investment on ethylene facilities, but this is being done, or otherwise alcohol would not be at its present price levels. Fermentation alcohol from molasses is only a minor factor now in establishing alcohol prices.

Similarly, the direct oxidation process for glycol is apparently the most economic since all of the new units of the past few years use this process rather than the chlorohydrin route. Each pound of glycol requires almost a pound of ethylene; conversion costs may be approximately 5 cents per pound. Recent bids on government contracts were in the range of 8 to 9 cents per pound, although this is admittedly below the present commercial level. Here again, the non-integrated producer cannot be competitive. For this reason it will be noted that all producers of synthetic alcohol or glycol are integrated.

"There will be a reduction in prices for polyethylene so that finished projects will show a very substantial decrease in cost. This will certainly broaden the market, perhaps sufficiently to take care of all of the new production."

What's the Outlook for Polyethylene?—Another so-called petrochemical is polyethylene which has received considerable publicity over the last few months, with many new producers scheduled to go into production during 1955. Polyethylene is termed a "so-called petrochemical," because many people do not realize that until recently I.C.I. made all of their polyethylene from ethylene produced from fermentation alcohol. In this country, of course, it is derived from petroleum raw materials.

Recently *Fortune* had an excellent article on polyethylene. However, developments since that time have modified some of the conclusions. Despite earlier statements, no polyethylene production is expected from any of the new producers before April of 1955 at which time National Petro-Chemical and one other producer expect to start production. This start-up date is probably conservative, but National Petro-Chemicals will spend no sizable amounts of money for overtime, if required to meet this target date, since such expenditure is certainly not warranted with the projected supply situation.

It is estimated that the total production of polyethylene by new producers in 1955 will not exceed 75 million pounds, with the likelihood of production not exceeding 50 million pounds. Further, of this production, a sizable percentage will not be suitable for film or bottles due to the start-up difficulties and to the necessity for new producers to acquire operating experience before top quality material can be produced.

Thus, the situation in 1955 is not expected to be as competitive as previously predicted. However, by 1956, the situation will be quite different since by then all of the new producers should be tuned up and operating at high production rates. However, the smaller-than-predicted production in 1955 will move the growth pattern forward almost a year, which will give greater opportunity for development of the polyethylene market and thus will have a tendency to ease the growing pains.

There has been a lot of conjecture as to the price level for polyethylene. Originally, some of the projections were thought to be a form of cold warfare to discourage new producers and certainly this may have been one of the factors influencing some of the projections. However, all producers must be realistic and realize that polyethylene has been greatly overpriced over the last few years due to the fact that demand was greater than supply.

A further reduction in price is anticipated just prior to the time that the new producers come into operation in 1955. There will probably be a further reduction in 1956 and subsequent years until polyethylene reaches a price level of 30 cents plus or minus 2 cents by 1958-60.

Personal experience indicates that a rough rule of thumb is that factory cost before central office overhead and sales expense, freight, etc., should be 50 percent of market price. Using this rule, it would be necessary to produce polyethylene at a factory cost of 15 cents per pound or less. This figure can be readily obtained by the integrated producer but will be difficult or impossible to reach for the non-integrated producer whose bare cost of 99.9 percent ethylene is 7 to 8 cents per pound of polyethylene. For this reason the integrated producer is expected to establish the ultimate price level for polyethylene with the non-integrated producers following their lead.

What About Low Pressure Polyethylene Processes?—There has been recent publicity on a low pressure process for producing polyethylene. At first sight it might appear that this process would make obsolete the present high pressure processes. However, evidence indicates that the cost of production and the selling price of low pressure polyethylene will not be far different from the present process since it probably requires the use of a metallic catalyst which must be removed and solvents which must be recovered.

The low pressure polyethylene may end up as a new specialty material which will be superior to high pressure

polyethylene for certain uses due to its higher tensile strength, higher melting point and greater stiffness, but inferior for many other uses. The greater tendency of the polymer to orient in processing equipment may result in poor transverse properties which will offset the benefits of the higher tensile strength. The material, because of its greater stiffness, will be much more difficult to process and may actually require redesign of some of the existing equipment in order to handle it. Naturally these defects will be minimized by further research. Blends of low pressure and high pressure polyethylene may also result in superior material for some applications.

What About Polyethylene Pricing?—There will also be a comparable or possibly even greater reduction in prices to the processors of polyethylene so that finished projects will show a very substantial decrease in the cost which will certainly broaden the market, perhaps sufficiently to take care of all of the new production. However, it should be pointed out that some of the plastic companies who have been chortling over the polyethylene situation and ribbing the new producers very vigorously, will undoubtedly find that major reductions will also become effective on polyvinyl chloride, cellophane and many other plastic materials which will have to compete with polyethylene. Thus, the net effect of the lower price on polyethylene will be to lower substantially the price level of the whole plastics field.

In the case of polyethylene again, the non-integrated producer will be at a serious disadvantage to the integrated producer. It requires, roughly, 1¼ pounds of ethylene per pound of polyethylene. The integrated producer can produce his high purity ethylene with a few simple changes in operation, whereas the non-integrated producer must refine his ethylene at a cost of possibly ¾ to 1 cent per pound. Thus, the cost of ethylene to the integrated producer will be 3 to 3¼ cents per pound of polyethylene, as compared to 7 to 7½ cents per pound for the non-integrated producer. This will be a serious cost disadvantage when the market becomes truly competitive. The integrated producer can also divert lower purity recycle gases from the polyethylene unit to other ethylene consuming processes, whereas the non-integrated producer must either return recycle gas to his purification unit or operate at lower purity in his reactor system which is stated to affect quality adversely.

What About Cost Appraisal?—In appraising projects, an attempt has been made to avoid the fallacy of charging feed stocks in at cost of production rather than market value by two methods. This was particularly necessary in the case of the Tuscola plant which is solely a petrochemical plant, whereas many petrochemical operations are a small part of a major refinery or chemical plant and erroneous bookkeeping is not so apparent.

The first method is to allocate the entire plant investment to the salable products in proportion to their consumption of the utilities, intermediates (such as ethylene), their manpower or other suitable criteria. In the case of the Tuscola plant the total investment, including these allocations, is usually in the range of two to three times the battery limit cost of each unit. Thus the profits from each product are spread over the appropriate base and this gives a realistic picture of return on the investment.

Another method also used since it sometimes leads to slightly different conclusions, is to include in the cost of utilities and general facilities, a 15 percent return before corporation taxes on the fixed investment. This figure was selected to be slightly above the normal yield for utilities, but below the expected return for chemical projects, based on the theory that there is less risk of technical obsolescence on utilities and general facilities.

In the case of ethane which is the feed stock for the ethylene unit and in the case of the ethylene, a charge equivalent to 25 percent return on the fixed investment is added. This method of accounting results in a cost figure for ethylene slightly below the present fair market value.

> "Within the next two to three years, increased markets and new uses will take care of the present overproduction on many of the products. This will help stabilize the price level."

What's the Over-all Petrochemical Outlook? It might appear that there is some pessimism regarding the future of petrochemicals. Quite the contrary, it is still felt that petrochemicals are on the steep slope of the growth curve and that any change in the growth pattern will be of a temporary nature. Within the next two to three years, increased markets and new uses will take care of the present overproduction on many of the products which will help stabilize the price level.

On the other hand, it is reasonable to expect some real changes in the sort of price levels which have existed for many years on petrochemical products, some of which have shown fantastic returns. Of course, the present lower price levels will add impetus to technological advances which will offset in part the lower price. Certainly every petrochemical producer has become much more cost conscious than in the past and it is believed that larger budgets will be appropriated for research and technological improvements in the plants. It is general experience that there is a direct relationship between these expenditures and reductions in operating costs.

Original presentation was before the Chemical Market Research Association, May 20, 1954, in New York.

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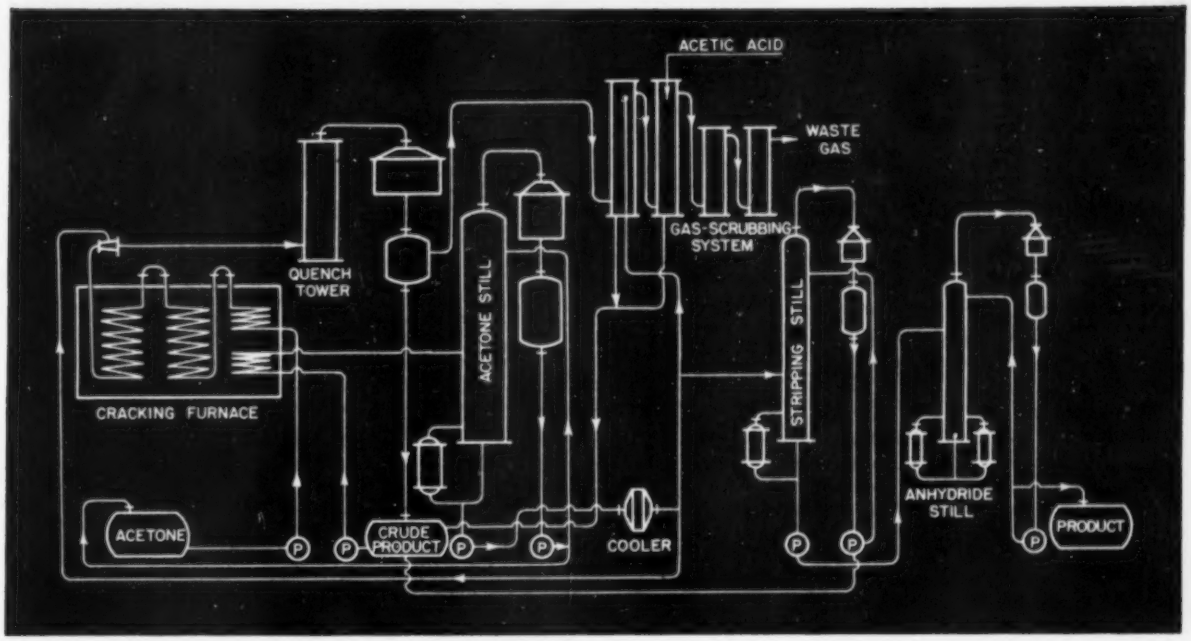


Figure 1. Flowsheet of the Courtaulds, Ltd., plant for the production of acetic anhydride. Acetone is cracked to ketene which is then combined with acetic acid to form the anhydride.

Valuable Intermediate: Ketene

Ketene is an important intermediate in the production of acetic anhydride and acetate esters. Described is a petrochemical process for its production from isopropanol.

Kenneth A. Kobe, University of Texas, Austin

WHAT ORGANIC chemical is produced to the extent of 125 million pounds annually, yet not a drum of it is sold? Ketene ($H_2C=C=O$) is little known outside of certain petrochemical plants and the extent of its industrial production[5] is little known. In the same way, its chemistry is usually relegated to obscure passages in the textbooks of organic chemistry. Ketene can be considered as the inner anhydride formed by the removal of one molecule of water from a molecule of acetic acid.

$$CH_3COOH \rightarrow H_2C=C=O + H_2O \qquad (1)$$

It is used immediately on the site of its production for the manufacture of acetic anhydride and acetate esters.

$$CH_3COOH + H_2C=C=O \rightarrow (CH_3CO)_2O \qquad (2)$$

$$R \cdot OH + H_2C=C=O \rightarrow CH_3COOR \qquad (3)$$

Ketene is a relatively latecomer in organic chemistry, as it was not discovered until 1907, when Wilsmore[20] reported it among the gaseous products resulting from the pyrolysis of acetic anhydride and acetone in contact with an electrically heated platinum wire.

Ketene from Acetone—One of the important methods of production is to decompose acetone by pyrolysis in a hot tube to form ketene and methane,

$$CH_3COCH_3 \rightarrow H_2C=C=O + CH_4 \qquad (4)$$

as was first shown by Schmidlin and Bergman[18] and extended by Hurd and Cochran.[12] The latter workers passed the vapors from boiling acetone at atmospheric pressure through a glass combustion tube filled with broken porcelain and heated to a temperature of about 600 C. Ketene, mixed with methane, carbon monoxide and ethylene, was obtained in a 25-29 percent yield. This work has served as the basis for the commercial processes revealed in the patent literature.

The presence of carbon monoxide and ethylene in the product gases indicated decomposition of the ketene, which Nightingale[15] suppressed by having "preventive catalysts," such as aluminum or other sulfates not decomposed at the temperature used. At 635 C. a yield of more than 80 percent of theoretical was claimed, whereas without preventive catalyst the yield fell below 20 percent.

Eastman Kodak Company showed an early interest in ketene, as indicated by the patent of Clarke and Waring.[3] They found that undesirable reactions which deposited carbon in large quantities were catalysed by iron and nickel salts, but that copper and silver represented an excellent filling for pyrolysis tubes so that heat would be conducted rapidly to the center of the tube. By operating a copper reaction tube filled with copper turnings at 650-670 C. they were able to obtain a total yield of approximately 80 percent.

Ketene . . .

Rohm and Haas Company was assigned a patent granted to R. O. Rice[17] in which he used a pure silica tube so that all catalytic effects were excluded. Rice claimed a temperature range from 550 to 1200 C. and pointed out that higher yields were obtained at higher temperatures, as 700 C. was better than 600 C. Also, the total yield increased as the conversion per pass decreased, and Rice preferred to decompose about 10 percent of the acetone per pass and recycle the unconverted acetone.

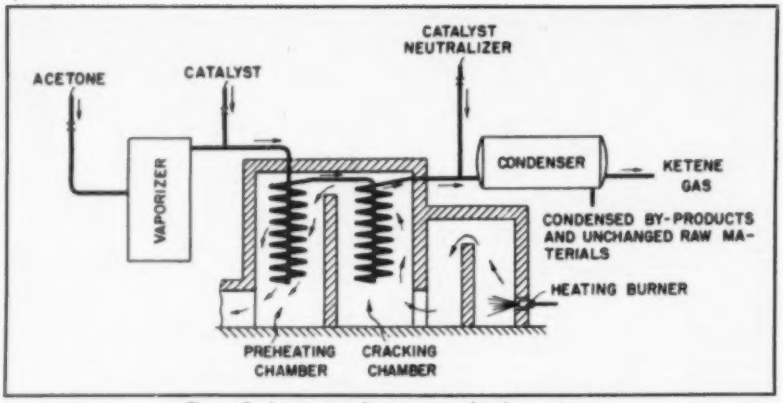


Figure 2. Acetone to ketene: two-chamber system.

Carbide and Carbon Chemicals Corporation showed its interest in the field by having the patent of G. H. Reid.[16] It was shown that an iron containing 10 to 30 percent chromium, but no nickel, would not catalyse the formation of carbon at temperatures below about 550 C. Reid used an alloy tube for the initial heating of the acetone, but the actual pyrolysis was conducted in a copper tube at 600 to 750 C., 5 psig, and space velocity of 2500 to 3500 liters per liter per hour, resulting in a conversion of 15 to 22 percent per pass.

C. H. Greenewalt, now president of E. I. du Pont de Nemours and Company, developed a ketene process for his company in 1936.[7] The solubility of the ketene in the unconverted acetone caused considerable loss of ketene. This was avoided by leading the pyrolysis gases through cooling coils to reduce their temperature to the dew point, then upward through a reflux condenser to give vapor phase separation of the ketene from acetone due to the acetone being at its boiling temperature. Graves and Greenewalt[6] later disclosed conditions of operation for the pyrolysis. They introduced the concept of mass velocity, or mass flowing across unit area in unit time. They used a copper tube of sufficient diameter to permit a mass velocity of 50,000 pounds per square foot per hour without developing a back pressure of more than 3 atm. absolute. The pyrolysis temperature was 700-850 C. and the flow adjusted so that the conversion was 5 to 25 percent per pass. In this apparatus the yield was 92 to 65 percent.

Equipment Design—In a series of patents during 1941-51 Eastman Kodak Company covered numerous features of equipment design. Hopkinson[8] designed heat exchanger equipment to serve as the reactor and a condenser which used acetone vapors to cool the pyrolysis products. D. C. Hull, now manager of Texas-Eastman Company at Longview, Texas, obtained three patents claiming new equipment features. He found that a chrome-aluminum steel tube containing 20.0-21.5 percent chromium, 2.0-2.5 percent aluminum, and small amounts of manganese and and carbon, was satisfactory for a pyrolysis tube.[9] A second patent[10] claimed a chrome-nitrogen steel tube contained 18-40 percent chromium, about 0.2-1.5 percent nitrogen, and small amounts of manganese, nickel and carbon. Two coils are arranged in separate chambers, one for preheating and one for pyrolysis (Figure 2). A third patent[11] added a third chamber for superheating the acetone before pyrolysis. In his first two patents Hull mentioned catalysts for the pyrolysis, phosphorous-containing compounds as triethyl phosphate. The catalyst pyrolysis products must be neutralized with ammonia to prevent the ketene from forming undesired products.

Atwood[1] found that a copper alloy containing 8 percent aluminum permitted the use of higher pyrolysis temperatures, as 730-780 C., than can be used with copper alone. His apparatus (Figure 3) is representative of the simple type of apparatus that can be used for this reaction, though earlier patents pointed out disadvantages that were overcome to give higher yields.

Repressing Carbon Formation—Standard Oil Development Company recently obtained two patents on the prevention of coke formation in the pyrolysis of acetone. It found that an 18-8 chrome-nickel steel was satisfactory for the pyrolysis tube if it was treated in a certain manner. In their first patent[14] Nicolai et al. disclosed a process to condition the surface of the tube by forming coke from contact of acetone with the surface, removing the coke with steam and air and repeating these steps until coke no longer forms. Moise[13] claimed that the surface can be conditioned by contacting it at 1200 C. with carbon monoxide for 1-24 hours. It is believed that a thin film of a carbide covers the surface of the metal and prevents contact of the metal and the acetone vapors.

Tyler and Courtaulds, Ltd.,[19] claimed that stainless steel (18 percent Cr, 8 percent Ni, 1 percent Ti) could be used for the pyrolysis tube if the surface was treated with a sulfur compound. Carbon disulfide was dissolved in the acetone to the extent that 0.1 percent sulfur was present in solution intially and this amount could be reduced to 0.005 percent after the process had operated continuously for some time. The examples given showed that acetone alone deposited considerable carbon but the addition of carbon disulfide to the acetone immediately repressed carbon formation (0.002 percent in 11 hours in one example).

Booker and Young[2] used a relatively new technique for the pyrolysis—the pebble heater. A stream of heated ceramic pebbles was brought into the reaction chamber to maintain a temperature of 675-725 C. for pyrolysis. Carbon deposited on the ceramic pebbles was burnt off during the reheating of the pebbles.

The Courtaulds Plant—Courtaulds, Ltd., in England, produce large quantities of cellulose acetate for which acetic anhydride is essential for the acetylation reaction. Daroux[4] recently described the pilot plant work and construction features for the full-scale plant.

From an economic study, Courtaulds concluded that cheap isopropanol from petroleum cracking gases gave the most economical route to acetic anhydride. The dehydrogenation of isopropanol to acetone gives a cheap source of this compound for pyrolysis to ketene.

$$\underset{\text{isopropanol}}{CH_3CHOHCH_3} \rightarrow H_2 + \underset{\text{acetone}}{CH_3COCH_3} \rightarrow CH_4 + \underset{\text{ketene}}{H_2C{=}C{=}O} \quad (5)$$

Operation of a pilot plant for three months gave data necessary for plant construction. The main problems investigated were (a) the general feasibility of the cracking

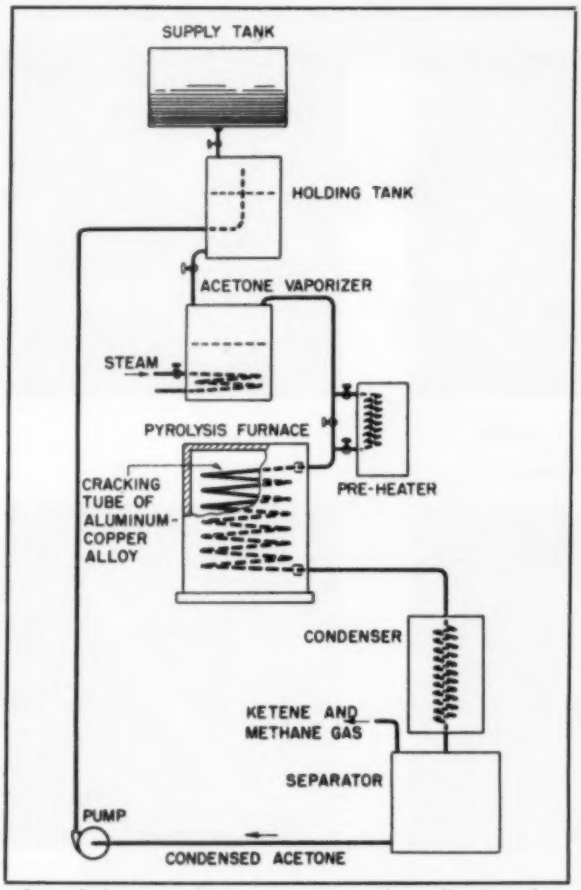


Figure 3. Acetone to ketene: equipment can be small and simple.

reaction, (b) materials of construction of the cracking tube, and (c) the conversion-yield relationship. The pilot plant consisted of a steam-heated vaporizer, preheating coil and pyrolysis coil separately gas fired, quench unit, absorption and distillation columns. The pyrolysis products were rapidly quenched with a recycle liquor which was largely acetic anhydride and acetic acid, which combined rapidly with the ketene (Equation 2). Unconverted acetone was separated by distillation and returned as feed. The feed acetic acid scrubs out the last of the ketene from the gases before they are discharged. The pyrolysis tubes were 25-20 Cr-Ni alloy of 1 inch nominal diameter. The formation of carbon deposits in the tube was prevented by the addition of small amounts of carbon disulfide to the acetone.[19] The conversion-yield relationship found in the pilot plant is shown in Figure 4. High yields of ketene were obtained at low conversion per pass, but fell off quite rapidly with increased conversion. An economic balance showed that the higher the price of acetone in relation to plant costs, the lower was the conversion that could be allowed in order to give an economical product. The unit was finally designed for a conversion of 25 percent per pass for maximum output. Lower outputs could then be obtained with increased yield.

The flowsheet of the entire process is shown in Figure 1. A special design of the cracking furnace gives excellent thermal efficiency and allows rapid replacement of tubes, if necessary. It was found essential to quench the pyrolysis products as rapidly as possible to prevent the decomposition of ketene to ethylene and carbon monoxide. The hot gases are quenched by injection of one of the recycle streams containing an excess of acetic acid. A four-jet

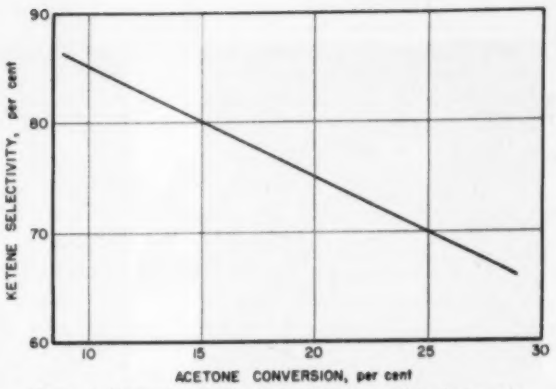


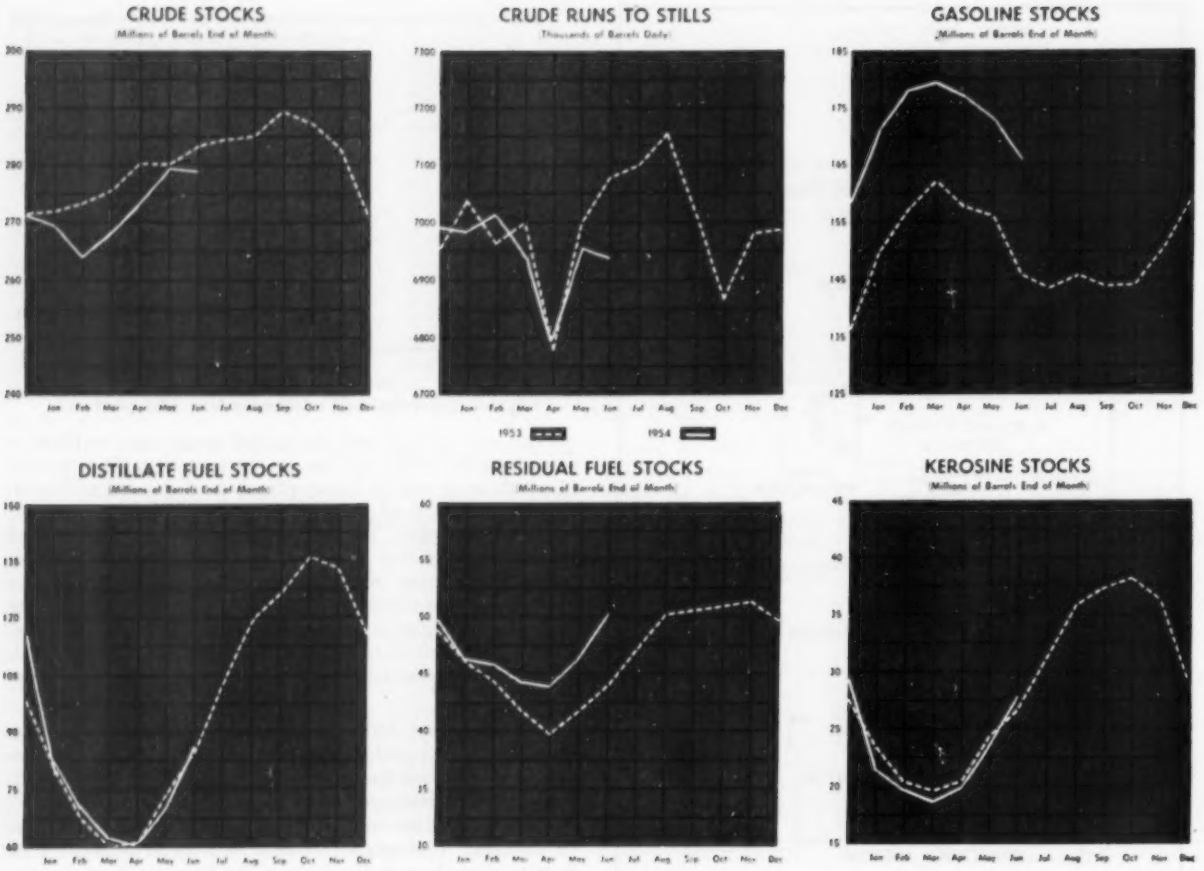
Figure 4. Conversion-yield relationship from pilot plant work.

quench unit is used and the cooled gases, now containing considerable acetic acid vapor pass to a packed quench tower through which liquid quench is circulated with continuous filtration to remove suspended coke blown from the cracking tubes. The vapor is condensed and much of the ketene combines with acetic acid during this step, so that the condenser must contain additional heat transfer surface for this exothermic reaction. The remainder of the process equipment is largely standard absorption and distillation equipment to separate the acetic anhydride product and the unreacted acetone to be recycled in the pyrolysis step.

Conclusions—Although the acetone-ketene process has operated as a pyrolysis at high temperatures, thermodynamics points out that temperatures over 500 C. need not be used and satisfactory yields can be obtained at 400 C. An active catalyst would allow these lower temperatures to be used. The catalyst should be a good conductor of heat to allow heat to flow in rapidly from the heated walls of the reactor. Because the reaction is endothermic it would be desirable to supply some of the heat in the form of an inert gas of high heat capacity present with the acetone vapors. In the dehydrogenation of ethylbenzene to styrene, steam is added in large quantities to the reaction mixture to prevent the reactor temperature from decreasing too much. Although steam could not be used in this reaction, an inert gas might be used. The inert gas would also decrease the partial pressure of the acetone and favor the equilibrium formation of more ketene. The inert gas would also serve to conduct heat from the walls of the tube and maintain a better temperature distribution within the catalyst bed. Where acetic anhydride is to be made directly from the ketene the inert gas might be acetic acid with which the ketene will later react, or acetic anhydride, providing that pyrolysis or dehydration of these compounds will not occur.

LITERATURE CITED

[1] Atwood, F. C., U. S. 2,376,748 (May 22, 1945).
[2] Booker, H., and Young, R. J., U. S. patent application 175,287. U. S. Patent Office Official Gazette, **666**, 603 (1953).
[3] Clarke, H. T., and Waring, C. E., U. S. 1,723,724 (Aug. 6, 1929).
[4] Daroux, W. G., J. Applied Chem., **3**, 241-52 (1953).
[5] Ewell, R. H., Editor, Chemical Economics Handbook, Section VI, Stanford Research Institute, Palo Alto, Calif.
[6] Graves, G. D., and Greenewalt, C. H., U. S. 2,069,243 (Feb. 2, 1937).
[7] Greenewalt, C. H., U. S. 2,053,286 (Sept. 8, 1936).
[8] Hopkinson, F. J., U. S. 2,258,985 (Oct. 14, 1941).
[9] Hull, D. C., U. S. 2,232,705 (Feb. 25, 1941).
[10] Hull D. C., U. S. 2,393,778 (Jan. 29, 1946).
[11] Hull, D. C., and Saunders, W. R., U. S. 2,541,471 (Feb. 13, 1951).
[12] Hurd, C. D., and Cochran, P. B., J. Am. Chem. Soc., **45**, 515-21 (1923). Hurd, C. D., *Organic Synthesis*, Collective Volume I, p. 330-4.
[13] Moise, J. E., U. S. 2,537,687 (Jan. 9, 1951).
[14] Nicolai, L. A., Nicholson, E. W. S., and Smith, J. O., U. S. 2,537,079 (Jan. 9, 1951).
[15] Nightingale, D. A., U. S. 1,602,699 (Oct. 12, 1926).
[16] Reid, G. H., U. S. 1,975,663 (Oct. 2, 1934).
[17] Rice, F. O., U. S. 1,879,497 (Sept. 27, 1932).
[18] Schmidlin, J., and Bergman, M., Ber., **43**, 2821-3 (1910).
[19] Tyler, D. L., and Courtaulds, Ltd., British patent 629,211 (Sept. 14, 1949).
[20] Willsmore, N. T. M., J. Chem. Soc., **91**, 1938-41 (1907).


CRUDE STOCKS
(Millions of Barrels End of Month)
CRUDE RUNS TO STILLS
(Thousands of Barrels Daily)
GASOLINE STOCKS
(Millions of Barrels End of Month)
DISTILLATE FUEL STOCKS
(Millions of Barrels End of Month)
RESIDUAL FUEL STOCKS
(Millions of Barrels End of Month)
KEROSINE STOCKS
(Millions of Barrels End of Month)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1953
1954

Taking Stock

Cecil W. Smith
Economics Editor

(DATA IN THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		KEROSINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1952:													
September	6,518	7,017	264,723	3,428	120,991	350	35,021	1,502	117,252	1,230	56,200	615	932
October	6,518	6,883	269,776	3,301	120,062	352	33,289	1,458	120,721	1,203	53,052	643	1,038
November	6,487	7,049	267,852	3,416	129,509	393	32,199	1,510	116,096	1,299	53,069	624	984
December	6,634	6,952	271,928	3,361	136,028	421	26,842	1,509	99,582	1,302	48,706	603	1,165
1953:													
January	6,555	7,042	272,250	3,384	150,518	433	23,292	1,528	80,655	1,307	45,910	616	1,135
February	6,562	6,969	273,589	3,379	157,873	404	20,468	1,505	67,167	1,275	44,178	586	1,066
March	6,531	7,002	275,665	3,319	162,731	359	18,697	1,489	59,802	1,256	41,600	655	1,112
April	6,446	6,781	280,487	3,282	158,032	361	20,335	1,424	61,349	1,219	39,572	628	1,010
May	6,390	7,002	280,308	3,366	156,415	327	24,307	1,400	73,706	1,197	41,795	703	1,096
June	6,595	7,081	283,715	3,467	146,196	326	27,659	1,462	84,504	1,238	43,801	707	1,050
July	6,603	7,103	284,976	3,583	143,916	321	31,143	1,441	102,258	1,224	47,530	629	950
August	6,583	7,163	285,352	3,592	146,050	321	35,711	1,437	119,542	1,222	50,007	672	946
September	6,557	7,023	289,614	3,521	144,184	330	37,280	1,448	126,709	1,203	50,516	692	1,013
October	6,262	6,872	287,541	3,437	144,495	355	38,161	1,462	135,409	1,184	50,820	639	990
November	6,277	6,987	283,021	3,528	150,747	354	36,271	1,463	133,381	1,223	51,267	648	1,120
December	6,238	6,964	276,676	3,628	159,949	378	29,070	1,441	111,944	1,247	49,370	598	1,121
1954:													
January	6,240	6,947	270,811	3,431	171,704	390	22,013	1,467	81,044	1,271	47,474	617	1,143
February	6,379	7,068	266,918	3,476	179,950	412	20,183	1,545	70,390	1,241	47,119	621	1,144
March	6,507	6,923	271,867	3,375	181,297	353	17,533	1,458	60,270	1,168	44,249	654	1,088
April	6,615	6,811	280,310	3,404	177,006	322	19,656	1,374	61,721	1,140	44,362	574	950
May	6,471	7,038	282,250	3,482	177,606	302	23,892	1,372	73,581	1,148	47,009	708	1,021
June	6,486	6,939	278,636	3,375	165,575	291	27,655	1,388	85,693	1,163	50,564	676	1,062
Week Ended:													
7-23-54	6,268	6,774	277,800	3,366	158,844	273	31,069	1,408	98,412	1,075	53,585	763	1,157
7-24-53	6,569	7,125	279,110	3,483	141,708	298	29,873	1,424	97,830	1,254	48,886	598	939

Source: Data for last two months from API; prior monthly data from Bureau of Mines.

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UNUSUAL DESIGN for a chemical manufacturer. Note angle of ends of the 839 copper tubes. Fixed and floating heads are aluminum bronze. Photo from Camden Copper Works, Camden, N.J.

TWO COPPER mixers, used for coating and blending powder. Made by Camden Copper Works, including the rotating mechanism.

These two pictures show the versatility of Revere Copper. One, made for a chemical company, contains 839 copper tubes, and an unusual feature of the design is that the ends are cut at an angle. The fixed and floating heads are aluminum bronze. The other photograph shows two copper mixers, which rotate and are used for blending and coating powder. They are much like equipment employed in making coated candies.

These are examples of the special adaptability of copper. Both items were fabricated by the Camden Copper Works, Camden, N.J., which manufactures equipment to individual designs. Like Revere, it offers technical collaboration. It is an important Revere customer.

Remember, the copper shortage is over. Revere Copper is freely available now in plate, sheet, strip; rod and bar; tube and pipe; extruded shapes; forgings; lockseam tube and rolled mouldings. See the nearest Revere Sales Office. Write for free booklet, "Life Extension for Condenser Tubes."

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Meet Our Authors . . .

J. S. Bellah | H. E. Morris | C. L. Fleming | N. V. Hakala | L. E. Moody | F. C. Burk | L. J. Test | H. R. Jackson

Bellah and Morris Met While Doing Their Bits

J. S. Bellah and W. E. Morris, "What is the Octane Picture? Part 1," page 111.

Alabama-born Jack Bellah was graduated from the University of Tennessee in 1934 with a B.S. degree in chemical engineering. He spent the next year at the University of Texas on a TVA graduate scholarship and then set out to do his bit in the petroleum industry. Doing that bit has carried him into numerous projects. His association with Socony-Vacuum Oil Company and Stanolind Oil and Gas Company widen his experience.

In October of 1953 he joined E. I. du Pont de Nemours Company at Wilmington, Del. It was while working in this capacity that Bellah met his co-author, W. E. Morris, group supervisor at Du Pont's nearby Deepwater, N. J., plant.

Morris joined Du Pont in 1950 from Standard Oil Development Company, where he had made gasoline quality studies. At Du Pont he supervises laboratory and road knock programs, test car instrumentation and various test car performance investigations.

Morris holds a B.S. degree in chemical engineering from the University of Missouri.

Burk, Test and Jackson Represent a Department

F. C. Burk, L. J. Test and H. R. Jackson, "How Effective Are Gasoline Additives," page 97.

These authors represent The Atlantic Refining Company, Research and Development department, Philadelphia.

F. C. Burk has been assistant director of the Application Research division of the department since 1947. With Atlantic since 1936 he previously served as assistant supervisor of the automotive laboratory of the department and supervisor of the laboratory. He received a B.S. degree from the University of Pennsylvania in 1925 and an M.E. degree in 1937. He was employed by Vacuum Oil Company and Socony-Vacuum Oil Company, Inc., prior to joining Atlantic.

Since graduation from Swarthmore College, L. J. Test has been doing research work in the department. In 1943 he became assistant supervisor of the automotive laboratory and in November, 1948, supervisor of the laboratory.

H. R. Jackson is a graduate of Massachusetts Institute of Technology. Since then he has been doing research work on fuels and lubricants in the department. He became project engineer in the Lubricant section of the automotive lab in 1949 and advanced to group leader in the Research section of the lab last year.

Fleming, Hakala, Moody: Vital Cogs in Research

C. L. Fleming, Jr., N. V. Hakala and L. E. Moody, "Combustion Chamber Deposit Control," page 88.

One of the many projects under investigation in the Research division of Standard Oil Development Company's Esso Laboratories is combustion chamber deposit control. Mainstays of that division are C. L. Fleming, director, N. V. Hakala, assistant director, and L. E. Moody, head of the combustion work in the division.

Fleming received an A.B. degree from Dartmouth College in 1935 and a Ph.D. degree in organic chemistry at the University of Illinois in 1938, after which he joined the Esso Laboratories.

Hakala holds a B.S. degree in chemical engineering from Michigan College of Mining and Technology and a Ph.D. degree in chemistry from the University of Wisconsin. He has been with the Esso Laboratories since receiving the latter degree.

Moody received a B.S. degree in physics at Wesleyan University and a Ph.D. in physical chemistry at the University of Wisconsin. He joined the Esso Laboratories in 1944 and has done most of his work in the field of fuels and lubricants.

Murphy Has Relied On What He Learned

Louis J. Murphy, "Chart Solutions in Flange Design," page 131.

All too frequently individuals study in a particular field for years only to find themselves ultimately in a field which completely nullifies their preparation. Not so Louis J. Murphy, every-now-and-then contributor to PETROLEUM REFINER. For many years he has been a student of refinery and petrochemical plant design, construction and operation. This background has found utilization in his work as design engineer and operations supervisor with several different oil companies.

Five years ago Murphy and a partner set up a consulting firm. Murphy's training and background have again served him well in this venture, in which he makes studies of sizes of refinery and petrochemical plants.

Shell Quartet Views Phosphorus Additives

Robert E. Jeffrey, Leroy W. Griffith, Edward Dunning and B. S. Baldwin, "Improve Fuel with Phosphorus Additives," page 92.

This writing team is from Shell Oil Company. Robert E. Jeffrey is a special engineer in the Products Application department in New York; Edward Dunning is assistant manager of that department; Leroy Griffith is chief engineer in the Shell research laboratory at Wood River, Ill., and B. S. Baldwin is a research technologist on Shell's Manufacturing Research department staff.

Jeffrey was born at Oakland, Calif. He started with Shell in 1936, soon after obtaining a master's degree in mechanical engineering from Stanford University. He also received a bachelor's degree in engineering from Stanford.

Griffith has been chief engineer at the Wood River lab since 1948. Previously he served as junior mechanical engineer, junior research engineer, senior research engineer and chief research engineer. He joined Shell in 1937. He was born at Ostego, Wis., and holds a B.S. degree in mechanical engineering from the University of Wisconsin.

St. Louis born, Dunning is a graduate of Rose Polytechnic Institute, with a B.S. degree in mechanical engineering. He joined Shell in 1928 as a motor testing engineering assistant at Wood River.

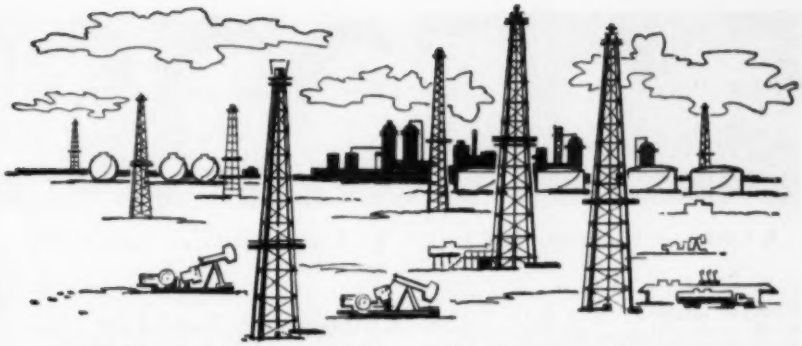
Baldwin holds bachelor's and master's degree in chemistry from Kansas State and a doctor's degree in chemistry from the University of Washington. He joined Shell in 1951 at the Martinez, Calif., refinery research laboratory, transferring to his present position in 1954.

Kobe Best Known For Three Activities

Kenneth A. Kobe, "Valuable Intermediate: Ketone," page 109.

Kenneth Albert Kobe, graduate professor of chemical engineering at the University of Texas, is best known for three of his many activities: his numerous writings in various publications, his teaching and his copious efforts in the industry.

Since 1926 he has been doing all three. He received B.S. and M.S. degrees in chemical engineering in 1926 and 1928, respectively, and a Ph.D. in chemistry in 1930 from the University of Minnesota. But it was after the first degree that



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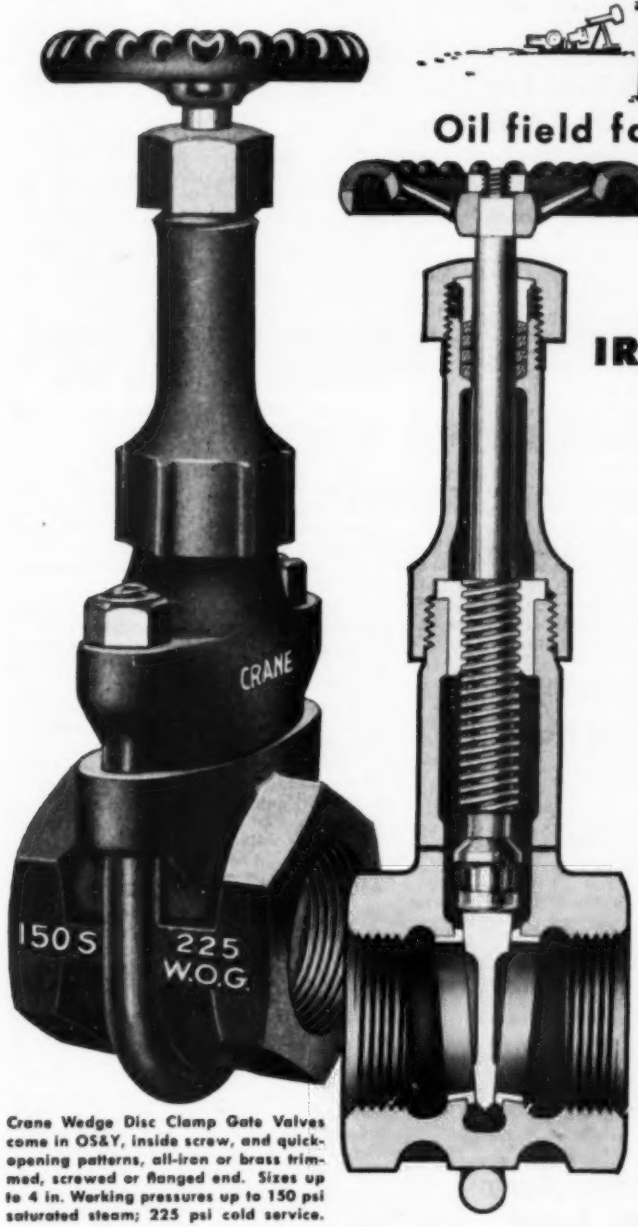

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K. A. Kobe O. L. Culberson H. T. Fort D. L. Katz G. Balekjian James Knudsen J. H. Rushton L. H. Garnar R. E. Hulse

he began teaching, first at the University of Minnesota, then at the University of Washington, and then at the University of Texas, where he has been since 1941.

He had a banner year in 1950. That year, for his series on methanol-lactic acid reaction, written with Dr. R. A. Troupe, he was given the AIChE Publication Award. And as chairman of the Chemical Engineering Projects Committee, he initiated an industry-sponsored school with the slogan "Teach the Teachers," which was conducted throughout the nation.

Today, in addition to his teaching, he is associate director, Bureau of Industrial Chemical at the University, which is engaged in research on Texas' natural resources.

Another Michigan Group Reports on Research Work

Donald L. Katz, James G. Knudsen, Garen Balekjian and S. S. Grover, "Fouling of Heat Exchangers," page 123.

This writing group is one of several which have turned out top-drawer articles on research work done at the University of Michigan.

A name which recurs in most of the groups is that of Donald L. Katz, professor of chemical engineering and chairman of the Department of Chemistry and Metallurgical Engineering at Michigan. He received a Ph.D. degree from Michigan in 1933, and joined Phillips Petroleum Company. Three years later he was back as assistant professor of chemical engineering, and he has been "back" since.

James G. Knudsen is presently an associate professor in the Chemical Engineering Department at Oregon State College. Previously he was an assistant professor at Michigan, and, before that, an assistant professor at Oregon. He holds a B.S. degree from the University of Alberta and a Ph.D. degree from Michigan.

Knudsen was for a while at Michigan studying heat transfer and fluid dynamics and heat transfer through finned tubes.

Heat transfer through finned tubes is one of the projects on which Garen Balekjian has been working to earn his doctorate at Michigan. Since 1951, Balekjian has been working towards the degree while employed part-time in the Engineering Research Institute. He was born in Cairo, Egypt, and has degrees from the American University at Cairo, the University of Texas and the University of Michigan.

Neither biographical data nor picture of S. S. Grover was available for this issue.

Culberson a Real Fan Of That Warm Texas Sun

Oran L. Culberson, "Recycle Process Material Balance," page 27.

The Texas sun, lambasted yearly by thousands of sweltering Texans, has at least one fan. He's Oran L. Culberson, chemical engineer, at Celanese Corporation of America, native Texan, and "bona fide sun worshipper."

Culberson's regard for old Sol has stemmed from a long acquaintance. Born in Houston, he received a B.S. degree from Texas A. & M. in 1943, and an M.S. in 1948 and a Ph.D. in 1950 from the University of Texas, all in chemical engineering. At Texas A. & M., he was a distinguished student and captain of the infantry band.

After getting his Ph.D., Culberson joined Gulf Research & Development Company as a development engineer, remaining there until going with Celanese at Clarkwood, Texas, in June of last year. His present assignment in Celanese's Petroleum Chemical Research & Development department is process design and economic evaluation.

Fort a Texan Who Found Green Grass at Home

Homer T. Fort, Jr., "Should You Start an Employe Publication?" page 84.

This native Texan has kept his activities pretty well within his home State. All the same he was graduated from high school in Paris (Texas, that is), and received both his B.J. degree and B.A. degree in government from the University of Texas.

Following service with the Air Transport Command in West Africa and India during World War II, he returned home and joined Magnolia Petroleum Company at its Beaumont, Texas, refinery in 1945. Initially assigned to industrial relations, he has since specialized in publications work and since 1952 has been director of publications and public relations, Refining division.

Rushton Scores Again Using Fourth Talent

J. Henry Rushton, "Mixers for Large Blending," page 101.

Triple-threat man J. H. Rushton is a chemical engineer, teacher and consultant. Since being graduated from the University of Pennsylvania, B.S. degree in chemical engineering and a Ph.D. degree, he has drawn freely upon each of his talents.

Today, in addition to being professor of chemical engineering at Illinois Tech, he is director of research for Mixing Equipment Company.

Rushton also has a fourth talent: writing. Author of over 40 technical papers on mixing, low temperature operations and other subjects, he is the recipient of the William H. Walker award of the American Institute of Chemical Engineering for outstanding contributions to the literature of chemical engineering.

Garnar's Outdoor Sports Reduced by Rising Hills

L. H. Garnar, "Cavitation Vs. NPSH Requirements," page 117.

This manager of the Process Pump section of the Centrifugal Pump division of Worthington Corporation has been working with centrifugal pumps, compressors and rock drills for 24 years. That's how long L. H. Garnar has been with Worthington in the Engineering and Sales departments.

Since 1937 he has handled centrifugal pumps for the petroleum industry. With promotion to his present post his duties were branched out to include the petrochemical and chemical industries.

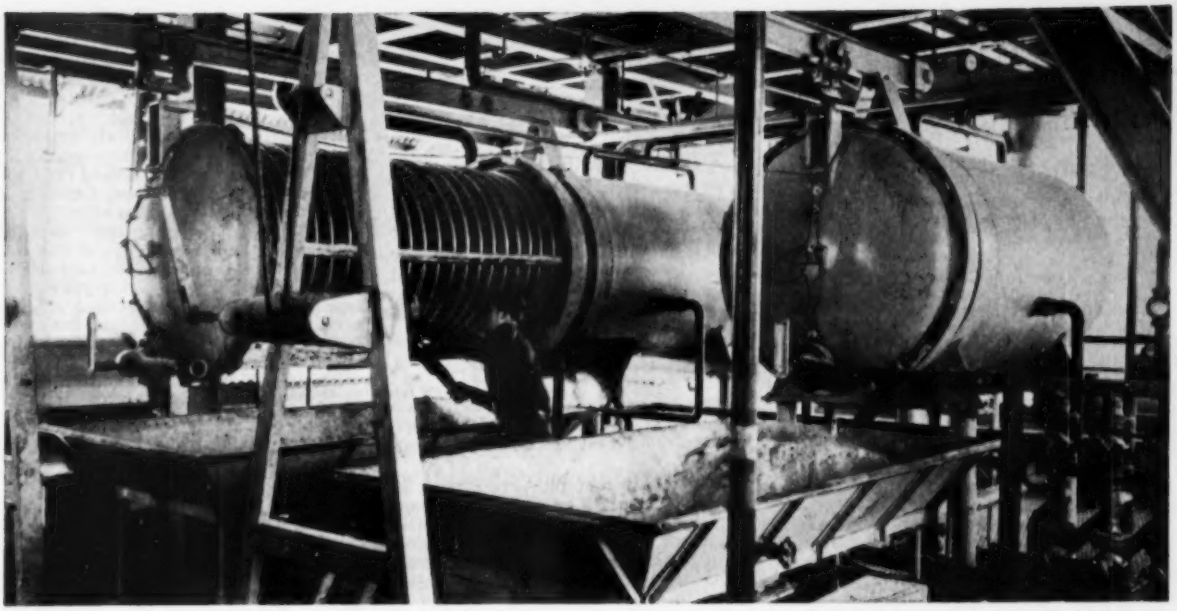
He is a mechanical engineering graduate of Rensselaer Polytechnic Institute and a licensed professional engineer in New Jersey. He used to enjoy four outdoor sports—swimming, skating, golf and skiing—but this list has been reduced to three "because the hills got too steep."

Hulse a Contributor To Petrochemical Growth

Robert E. Hulse, "Petrochemical Supply and Demand," page 139.

One of the many men who have made large contributions to the phenomenal growth of the petrochemical industry is Robert E. Hulse, vice president of National Distillers Products Corporation.

Since joining National as director of research and development in May, 1949, when National entered the chemical field, he has moved decisively. He first reorganized and amplified his firm's research activities. Then, transferred to New York, he guided its chemical operations, which recently made news with the opening of National Petro-Chemicals Corporation's new $50 million plant at Tuscola, Ill. Hulse was instrumental in laying the technical groundwork for Petro, which is jointly owned by National and Panhandle Eastern Pipe Line Company. Since June, 1951, he has served as executive vice president and director of Petro. He became a vice president of National in 1952.



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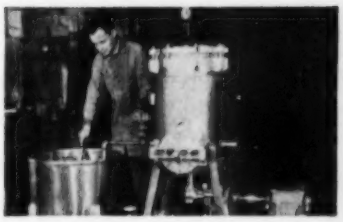

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Reviewing New Books . . .

Mathematical Statistics

Statistical Analysis in Chemistry and the Chemical Industry, Carl A. Bennett and Norman L. Franklin, John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. $8.

Techniques of applying mathematical statistics most frequently used in the chemical industry have been assembled into one book by Dr. Bennett, chief statistician with General Electric Company at Richland, Wash., and Dr. Franklin, lecturer in chemical engineering at the University of Leeds in England.

Their comprehensive treatment, prepared at a level between works on mathematical statistics and those dealing with the application of statistical methods, should find wide use by chemists and chemical engineers. The authors first develop, in logical sequence, the principles of statistical inference, and cover descriptive statistics, probability and samples, mathematical machinery and statistical inference. In the second part of the book, they develop specialized methods and include relationships between variables, analysis of variance and the design of experiments, analysis of counted data, control charts, etc.

The authors based selection of methods not only on their usage but also on the degree of correspondence between the practical situations from which data are obtained and the mathematical models on which inferences from these data must be based. In cases where more than one method is used to achieve the same result, the authors present the theoretical, computational, and practical considerations on which appropriate selections should be based.

Illuminating Oil Facts

Facts About Oil, American Petroleum Institute, Department of Information, 50 West 50th Street, New York 20.

This concise and pithy treatment of oil and the industry around it was issued to give editors and broadcasters background information about the oil industry in connection with the June Press Month project of API's Oil Industry Information Committee. A revision of the previously successful edition published in 1950, it far exceeds that short-lived purpose.

Short (31 pages) it touches on every facet of the oil industry, and tosses in for good measure a short history of the origin of oil. To be distributed to schools and colleges, libraries and other places where it will be used for reference, it should do much to illuminate that dark which too great a percentage of the public is in on the oil industry.

Plant Maintenance

Techniques of Plant Maintenance and Engineering—1954, Clapp & Poliak, Inc., 341 Madison Avenue, New York 17. $7.50 postpaid.

Every year in recent years engineers from every major industry—and from many foreign countries—attend the Plant Maintenance & Engineering Conference. Last January 2400 of them attended.

And every year since the meetings have begun the proceedings of the conferences have been gathered into a book and published. The resulting yearly volume has come to be regarded in engineering circles as the most important statement of current plant maintenance problems.

This latest annual volume is the most extensive ever published in the series. It contains texts of papers read by 24 authors and direct answers to more than 1300 questions. A new feature this year is a summary of 20 roundtable discussions, each of which ran five hours.

The two principal sessions this year were devoted to "Planning and Scheduling Maintenance Work," and "Maintenance Cost Control and Budgeting."

New Chemical Products

Successful Commercial Chemical Development, John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. $9.

New patterns of product development and the need for more efficient organization have prompted the writing of this 390-page book, which is to be published next month. Sponsored by the Commercial Chemical Development Association, it will be brought to the attention of

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Tornado hit here?

People in Lima, Ohio, couldn't even notice a dim-out of industrious sparkle in the lights of Sohio's refinery. On that night, though, hundred-mile-an-hour winds from a nearby tornado knocked out one of the refinery's two, 34-kv utility feeder lines. The "cat cracker's" 3000-hp blower motors were thrown out of synchronization and started an ominous whining slowdown.

In less than 4 seconds, three things happened: a Westinghouse Under-Frequency Relay took the motor drives off the line, so that the rest of the plant load could be reapplied in segments. DH air circuit breakers in

(continued next page)

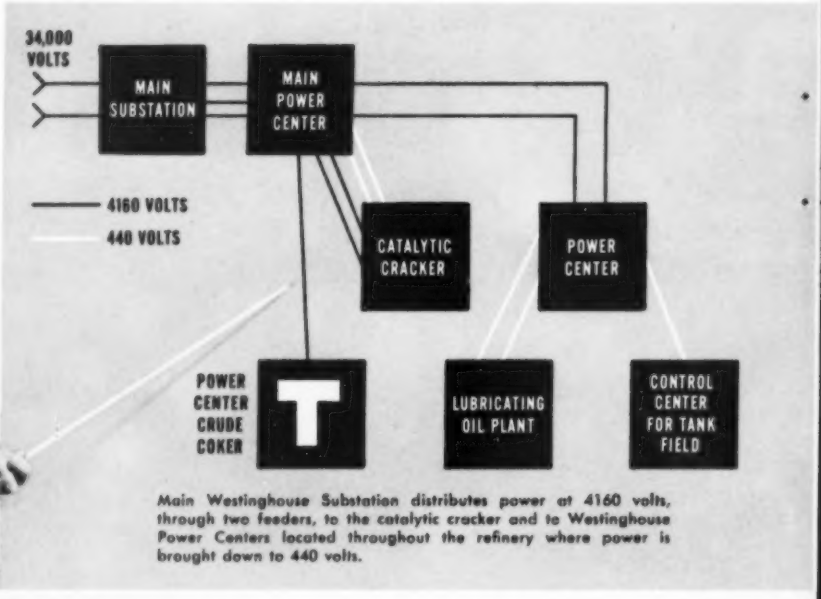
Meet Carl Olson, Westinghouse Industrial Engineer, who reports on how a new conception of power reliability resulted at Sohio's Lima Refinery through electrical distribution and drive control.

the main Westinghouse Switchgear automatically closed, bringing power in from the second utility feeder. Automatic control restarted the blower motors and a $30,000 outage was averted.

This absolute electric power reliability was the result of thorough planning by Sohio Engineers, the Dingle-Clark Co., and Westinghouse. They decided that quick restoration of power is the most efficient method of assuring continuous production from the refinery process. An ingenious control system was installed to automatically clear trouble in 4 to 5 seconds. The resulting electrical system brought important advantages in flexibility, economical operation and simplified maintenance.

At Sohio's Lima Refinery . . .

Speedy restoration of service is key to process protection



Main Westinghouse Substation distributes power at 4160 volts, through two feeders, to the catalytic cracker and to Westinghouse Power Centers located throughout the refinery where power is brought down to 440 volts.

Westinghouse 4160-volt Switchgear, left, is located in the main substation protecting refinery load of 16,200 kva. It provides under-frequency and automatic-starting control for the main blower motors.

Drawout feature of these high-voltage, Type DH, De-ion® circuit breakers allows them to be changed in only 3 minutes. Inspection and maintenance can be made simply and quickly with minimum disturbance to refinery operations.

. . . System growth at low cost results

The refinery's present duplex system is so planned that Sohio can add additional capacity easily in the future. Sohio engineers point out that they are now using 16,200 kva, and can go up to 25,000 kva without adding additional switchgear.

Standard, unitized construction of Westinghouse Substations and Power Centers will make it easier to expand or rearrange circuits when needed.

Westinghouse Power Centers add economy

Sohio engineers report that the compact and completely enclosed design of Westinghouse Power Centers permits installation near the centers of refinery load with resulting savings in power and cable, and at the same time conserves building space. Voltage loss at distant locations, such as tank-field pumping stations, is prevented. Motor drives operate efficiently at full rating.

Maintenance man-hours limited

On low-voltage circuits Westinghouse AB-I Circuit Breakers cut down maintenance time with 3-step protection. First, these breakers will not trip on light or short-duration overloads. Second, they will trip immediately in case of serious fault, but once the fault is cleared a flip of the breaker handle restores power. There is no time lost locating replacement fuses. Third, AB-I breakers always remain properly calibrated. There's no danger of under or over fusing.

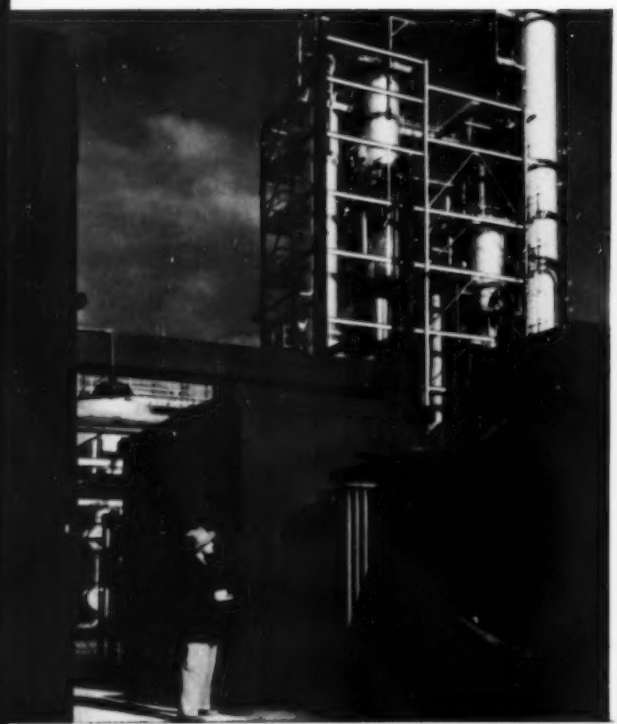
Westinghouse Field Engineering plays a part

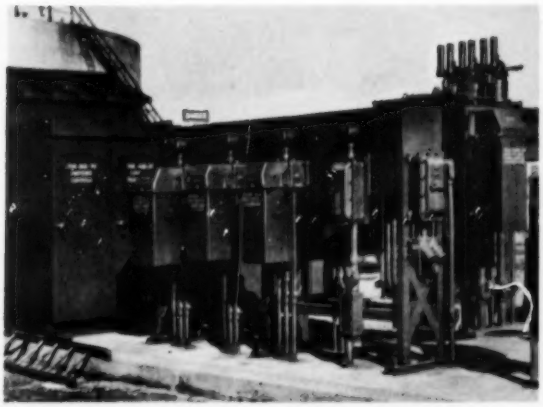
In the event of major electrical equipment damage, Sohio can always rely on Westinghouse Field Engineering Service. Available from 56 Field Service Offices, Westinghouse Engineers are on 24-hour call to take care of emergencies.

In addition, 38 Westinghouse Manufacturing and Repair Plants provide factory-type service. And 31 Westinghouse Renewal Parts Warehouses help to simplify many refinery inventory problems on electrical equipment.

Next page, steam or electric drives . . . how the decision was made.

YOU CAN BE **SURE**...IF IT'S Westinghouse





Oil-immersed, combination Life-Line Starter and AB-I circuit breakers are grouped together providing control and circuit protection for pump motors. Units are easily inspected by lowering oil tanks.

Westinghouse 440-volt, Outdoor Power Center for the Lubricating Oil Plant contains two 1000-kva transformers, 4160/440 volts, and 440-volt air breaker switchgear.

for continuous operation of Sohio's Lima Refinery . . .

Electric drives show lowest cost

Thorough study showed electrical drives to be the most economical way to expand Lima Refinery capacity to 50,000 bbls. per day. Westinghouse experience in supplying both steam and electric drives helped to point out lower electrical installation and operating costs.

Refinery operating efficiency is improved with the help of Westinghouse Motors and Control for the "cat cracker" blowers and synchronous motors on the Lubricating Oil Plant refrigeration compressors. These synchronous drives improve the system power factor and deliver more power per dollar.

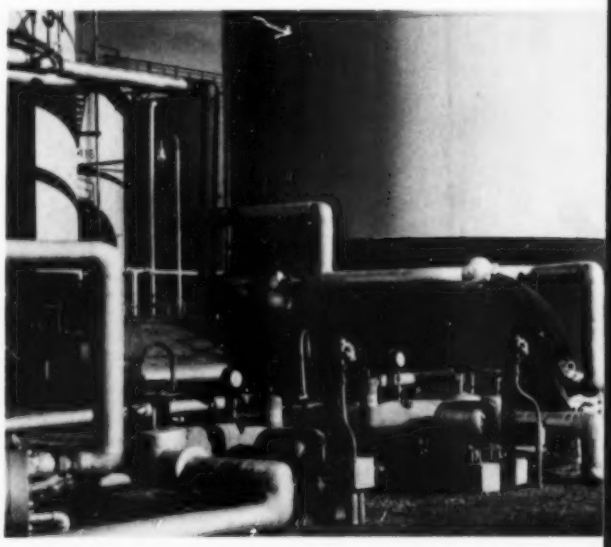
Life-Line® motor drives in the Lubricating Oil Plant and tank field require minimum attention. Sealed, pre-lubricated bearings and tough conductor insulation protect them from dust, moisture and corrosive action.

In analyzing refinery drive requirements, Westinghouse Engineers can help you with complete impartiality, too. Whether steam or electrical equipment proves more desirable, Westinghouse engineering provides dependable facilities for continuous refinery operation.

What to do NOW! Call your local Westinghouse Representative with questions on any of the equipment discussed. He'll supply you with copies of the literature listed below. Or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa.

- ☐ Power Centers B-4162
- ☐ High-Voltage, Metal-Clad Switchgear B-5306
- ☐ Low-Voltage, Metal-Enclosed Switchgear B-5282
- ☐ Dry-Type Transformers B-5920
- ☐ AB-I Circuit Breakers B-5456
- ☐ Preventive Maintenance Booklet B-5477
- ☐ Synchronous Motors and Control B-5300
- ☐ Motors and Control for Petroleum Industry B-5444
- ☐ Life-Line "A" Motors B-6154-A
- ☐ Life-Line Motors (200-700 hp) B-4731
- ☐ Large Induction Motors B-4739
- ☐ Complete Industrial Control and Services B-6051

Two Westinghouse 250-hp, 4160-volt synchronous motors with special enclosures operate safely in hazardous atmosphere. Westinghouse Engineers designed special hoods for purging the motors continuously with fresh air.



Pumping operations in the tank field are powered by Life-Line motors. Sealed, pre-lubricated Life-Line bearings eliminate the time and cost of greasing maintenance, prevent entry of dirt and moisture into the bearing. MP-3031

YOU CAN BE **SURE**... IF IT'S

Westinghouse

New Books . . .

the American Chemical Society at a joint meeting of ACS and CCDA September 12 because of the apparent high interest in this field among industry people.

The book's intent is best expressed in the Foreword:

"To document in one volume the most enlightened present-day knowledge of the important principles of every essential step, as well as the pitfalls to be avoided, in selecting promising new chemicals and rapidly developing them to the stage of economic importance."

Pressure Vessels

The ASME Pressure Vessel Code—A Joint Effort for Safe Construction, Elmer O. Bergman, Publications Department, C. F. Braun & Company, Alhambra, Calif.

The ASME Boiler and Pressure Vessel Code is a working technical document which reflects the views of those concerned with it on standards of design and fabrication of boilers and other pressure-vessels. It is prepared under the sponsorship of the American Society of Mechanical Engineers by a group of experts from many fields such as metallurgy, stress-analysis, welding, construction and inspection.

Kept timely and partial to no group affected by it, the code has won voluntary acceptance by manufacturers and users. It has been given legal sanction by many state and city regulatory bodies. This joint effort on the part of ASME and the regulatory agencies has resulted in a much-needed rise in the safety standards in this field.

This book, originally presented as a paper before an ASME Conference recently held in Houston, deals with the development of safety codes for pressure-vessels, beginning with a summary of the conditions prior to the formation of the Boiler Code Committee. It covers the first boiler code, the evolution of the pressure-vessel code, the problems of welding, the API-ASME Code and the general revision of the ASME Code.

Updating Compressed Air

Compressed Air Handbook, McGraw-Hill Book Information Service, 327 W. 41st Street, New York 36. $8.

Latest innovations in the industrial uses of compressed air power are described in this new Second Edition of the *Compressed Air Handbook*. Prepared by the Compressed Air and Gas Institute, it covers air and gas compressors of all types. It describes the use of compressed air and gas power in operating pneumatic tools, rock drills, and other air-operated devices; and covers the theory, selection, application, installation, testing and maintenance of equipment.

Extensively changed from its predecessor, the Second Edition is almost an entirely new book. It has practical case-study information supplementing its wealth of facts, and a new chapter devoted to centrifugal compressors. It has twice as many descriptions of applications and photographs as before. It is a revised book which offers specialists in compressed air power information on the recent advances in their field.

FOR EFFICIENT PILOT PLANT and SHORT-RUN GREASE PRODUCTION
SATISFACTION PATTERSON MACHINERY
THE PATTERSON COMPLETE GREASE PLANT
Compact, clean and safe, this completely-integrated Grease Plant is a big package in small working space. Every facility for controlled, low-cost grease production is provided. Write!
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For more data on advertised products, use Readers' Service Cards, last page.

WHY 2 OF DENVER'S 5 REFINERIES SELECTED NICHOLSON STEAM TRAPS

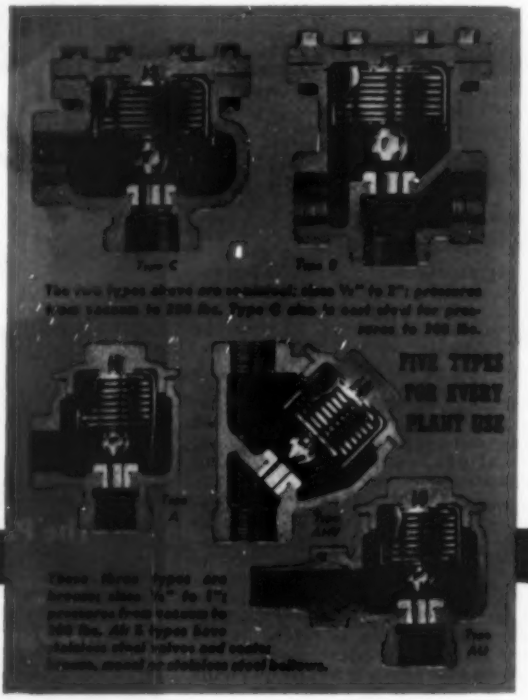
may be important to you

LIKE many industrial plants, the two operations referred to above had been using a considerable number of different kinds of steam traps. Both refineries have standardized on Nicholson traps, for practically all applications, for these basic reasons: Nicholson traps were found to be the most effective in improving heat transfer and in promoting production efficiency. These are advantages which, we believe, are of interest and importance to plant men in every industry.

A recent survey showed these Nicholson features to be reasons why an increasing number of leading plants are standardizing on Nicholson thermostatic traps:

1) Two to six times average drainage capacity; shorten heat-up time.
2) Operate at lower temperature differential; fast action keeps equipment full of live steam; higher and more even temperatures.
3) No air binding; eliminate costly fluctuation of operating temperatures.
4) Freeze-proof; drain completely when cold; can be freely installed outdoors.
5) Only one moving part; minimum maintenance.
6) No need to change valves for varying operating pressures from vacuum to maximum allowable.
7) Record low for steam waste; as little as 1%.

Types for every process, power and heat application.



Send for CATALOG 953
Contains installation diagrams and data for determining proper size of trap.

NICHOLSON

TRAPS · VALVES · FLOATS

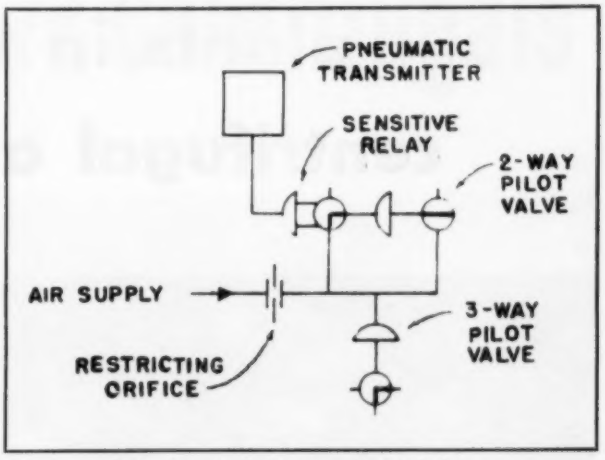
207 OREGON ST., WILKES-BARRE, PA.

Sales and Engineering Offices in 38 Principal Cities

How to Do It . . .

Versatile Pneumatic Interlock

Here is a fast-operating, reliable system for obtaining the protection of interlocking controls.



Basic element of the pneumatic interlock . . .

Multiple application can be obtained with this pneumatic interlock, which was originally developed for a particular process control. Because of its simplicity and flexibility, it can be adapted to a variety of functions with minor modifications. Proved reliable, it requires no maintenance other than routine servicing.

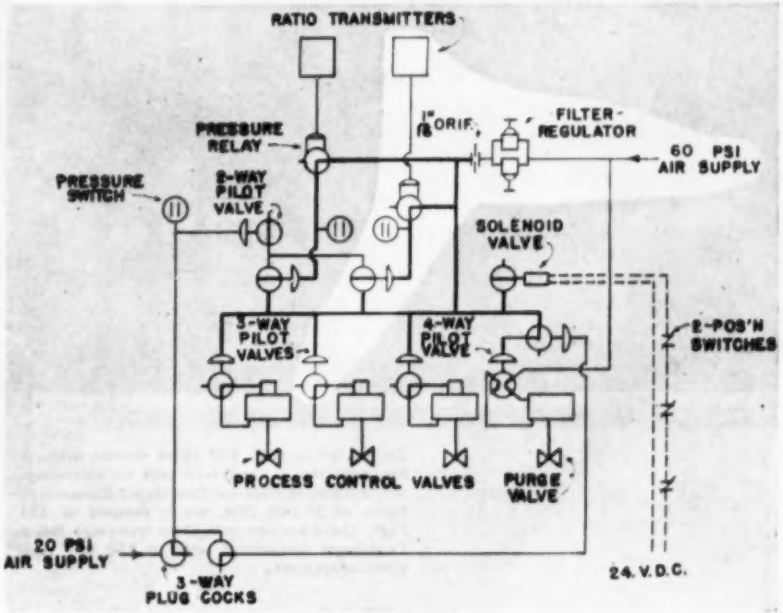
Operation. Figure 1 shows the basic element of the interlock and illustrates the principle of its operation. The three-way diaphragm operated pilot valve is held in open position by air admitted through a restricting orifice. Air pressure is maintained on the valve diaphragm by a two-way diaphragm operated pilot valve, which is held closed by air pressure from the sensitive pressure relay. The relay is actuated by the process variable transmitter. When the output of the transmitter reaches the set point of the pressure relay, the relay vents the diaphragm of the two-way pilot valve which causes the three-way pilot valve to operate. The three-way pilot valve is used to open or shut a process control valve.

Several features of this arrangement are apparent. The system is "fail-safe" in operation; loss of air supply to any component operates the process control valves. Secondly, since the air supply to the pressure relay is connected after the restricting orifice, return of the transmitter signal to a safe value will not reactivate the system. The interlock must be reset before the process control valves can be operated. Again, by proper sizing of the restricting orifice, the piping, and the two-way pilot valve, the interlock can be made to operate in a fraction of a second.

Application. Figure 2 shows the interlock as applied to a particular process. In this system the interlock is actuated by either of two ratio computers or by remote manual switches. Because in their first application of this system wiring and electrical switches were already installed, the remote manual operation of the interlock was made electrically actuated. However, the solenoid valve can be replaced with a diaphragm operated valve.

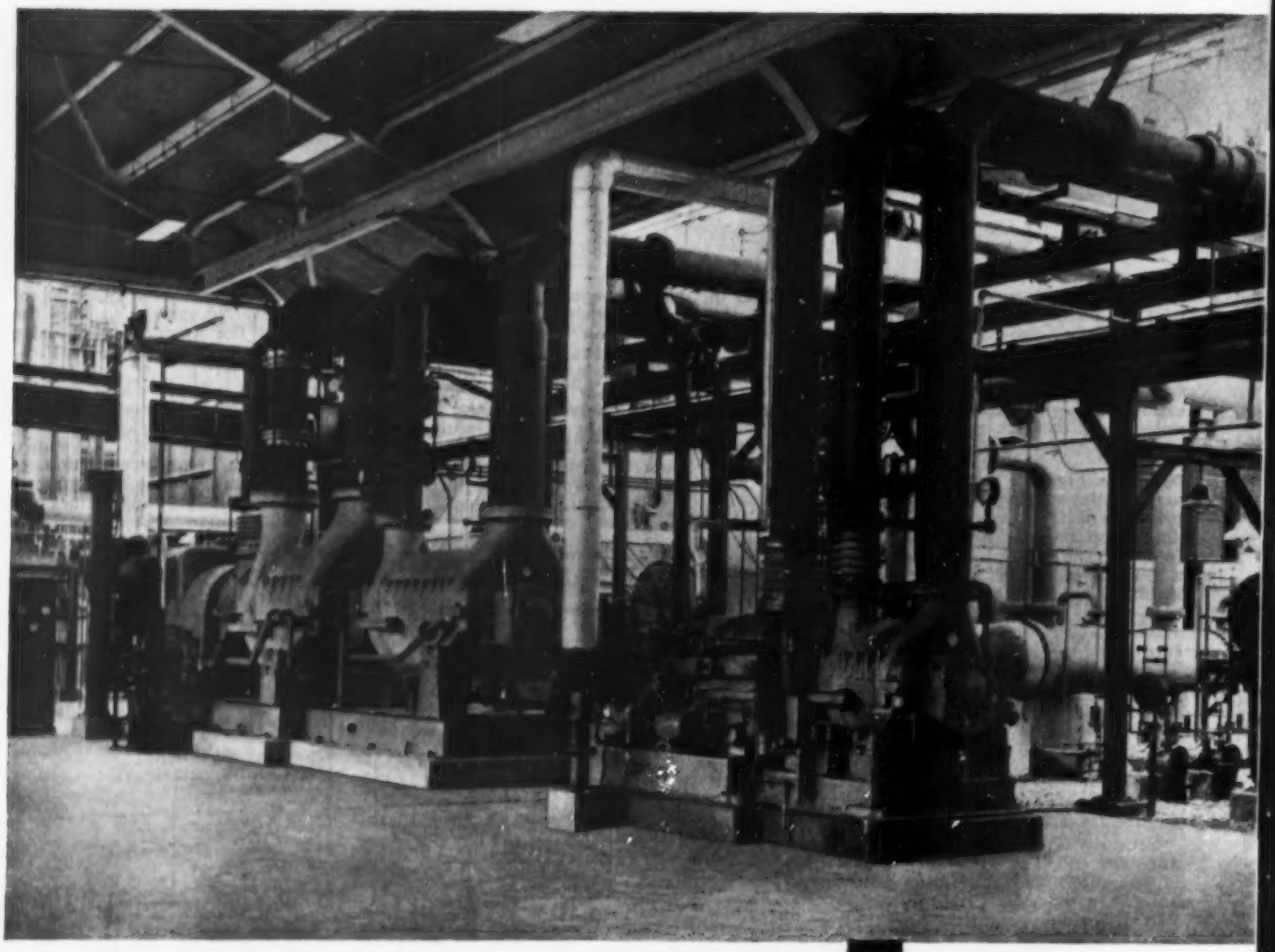
Operation of the interlock vents the air from the diaphragms of the three-way pilot valves in the line from the positioner to the cylinder operator of the process control valves and from the diaphragm of the four-way pilot valve which controls the purge valve. Pressure switches actuate an audible and visual alarm to indicate which variable tripped the interlock. The alarm system is independent of the interlock.

The first three-way plug cock shown was installed to permit operation of the process control valves during start-up before proper operating values are



. . . and this is the complete interlock as applied to a process.

Three newest partial oxidation plants in the U.S. use centrifugal air compressors



On the left a 5000 BHP steam turbine drives a five-stage No. 4 Compressor and an eight-stage No. 3 Clark Multi-Stage Centrifugal Compressor. Rated at 20,000 CFM, air is pumped to 125 PSIG. The other unit is a Clark four-stage No. 2 Centrifugal Compressor rated at 650 BHP compressing nitrogen.

all 3 select Clark Centrifugals

When Spencer Chemical Company's new Vicksburg, Miss. ammonia plant recently went on stream, it became the first of three new plants which will use centrifugal air compressors in the partial oxidation method of making hydrogen. Significantly, all of the plants have selected Clark Multi-Stage Centrifugal Compressors.

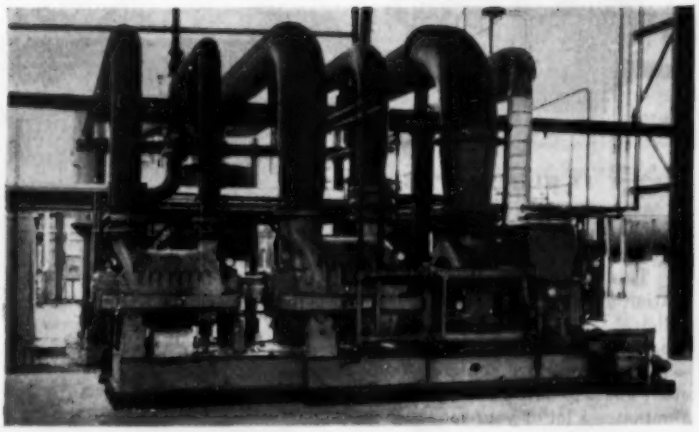
The new Spencer Chemical plant, which manufactures ammonia, nitric acid, ammonium nitrate and ammoniating solutions, is outstanding for its compactness and high degree of process integration.

The continued preference for Clark Centrifugals to serve varied process applications is the natural result of many points of superiority which your nearest Clark representative will be glad to detail for you.

CLARK BROS. CO. • OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

Sales Offices in Principal Cities Throughout the World



A 3800 BHP turbine driving a five-stage No. 3 and an eight-stage No. 2 Clark Centrifugal Compressor. Capacity of this unit is 15,000 CFM with a discharge pressure of 125 PSIG.

5 outstanding Clark Centrifugal features

STANDARDIZATION
Simplifies installation, operation and maintenance. Units readily adaptable to existing pipe arrangements and future plant expansion.

SEALING
Clark leads the field in the number of available types and the development of new seals for specialized uses.

RUGGEDNESS
Unitized design. Bearing chambers cast integral with case. Accurate alignment maintained at high speeds and pressures.

TESTING
Clark experience in handling so many different and difficult applications saves you money and speeds your delivery by eliminating the need for performance testing. Only a mechanical test is required. Clark knows the performance of its machines.

COOLING
Enables accurate control of process temperatures. Cooling and compression duties separated. Reduction in horsepower. One unit often can do the work of two.

CLARK

compressors

Clark sets the pace in compressor progress

For more data on advertised products, use Readers' Service Cards, last page.

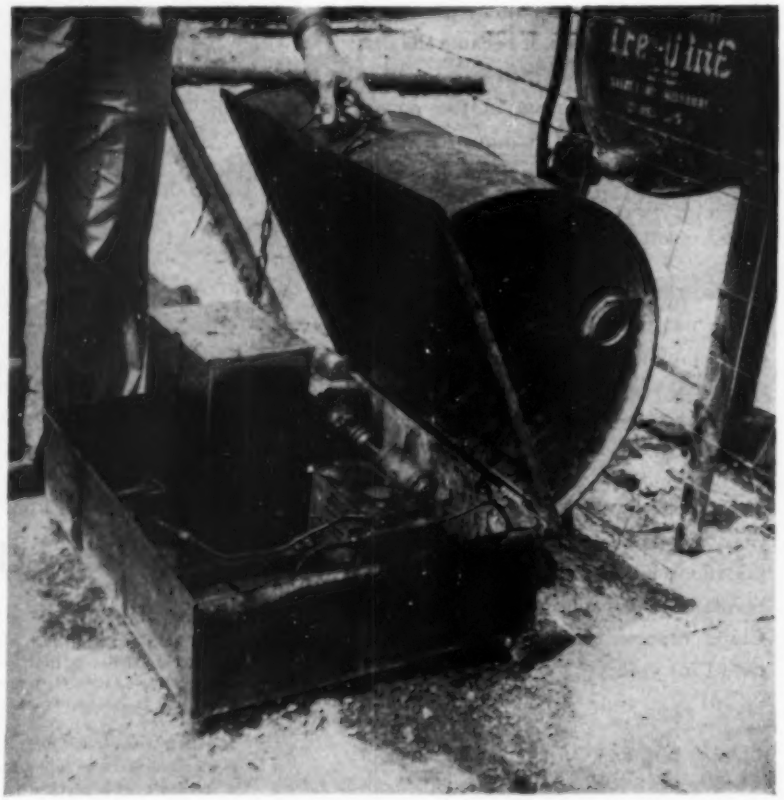
established and to permit resetting the interlock after it has operated. In the "off" position, this three-way plug cock admits air to the diaphragm of the two-way pilot valve to close the vents from the two vent valves. Air is also supplied through the first three-way plug cock to a second three-way plug cock to permit operation of the process purge valve independently when the interlock is in the "off" position. A pressure switch energizes a visual alarm to indicate the position of this "on-off" plug cock.

When the interlock has been operated automatically, the first three-way plug cock must be turned to the "off" position to permit operation of the process control valves.

Properly sized orifices are installed in the vent ports of the three-way pilot valves to regulate the closing speed of the process control valves, thus insuring proper sequence of operation.

The over-all operating time from energizing the sensitive relay to complete closing of the process control valves is 1.6 seconds when the control valves are wide open and 0.7 second when the control valves are in normal operating position. Practically all of the operating time required is due to the closing speeds of the process control valves.

This paper was originally presented at the Symposium on Instrumentation for the Process Industries, College Station, Texas, January 29, 1954, by T. J. Kirwin, E. I. du Pont de Nemours & Company, Victoria, Texas.



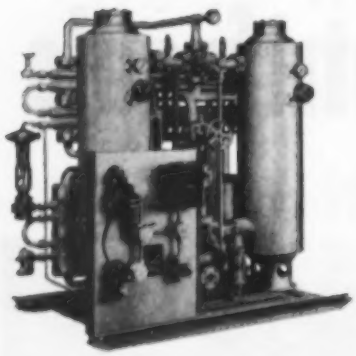
Scraps Make Injector Housing

How to Do It . . .

Service life of chemical injectors can be extended appreciably by housing them in all-weather structures. Here is a small field installation that encloses all the essential operating equipment for injecting a corrosive inhibitor into flow lines.

Top of the structure is half of a regular metal oil drum that has been flanged along the edges of the cut as shown. Base of the weatherproof housing is a sheet metal box that serves as a foundation for the chemical supply sump, the pump and an electric motor which powers the pump. The metal box is placed on four short sections of pipe driven into the ground so that the box is approximately level. The semi-circular lid is hinged to one side of the box, and fitted with a chain that supports the lid when opened slightly beyond the 90-degree angle. A drum of inhibitor is located nearby so that the job of filling

Pritchard
HYDRYER



IT ELIMINATES
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This dependable Pritchard dehydration unit—a packaged dryer proved efficient in all types of industrial, processing and laboratory installations—reduces moisture content of air or other gases to desired dew points. That eliminates a lot of your moisture problems . . . gives you a good reason for owning a HYDRYER*. There are other good reasons, all of which will save you money.

Here are examples: A HYDRYER will eliminate costly plant and equipment shutdowns due to moisture and ice; it will protect precision instruments and controls; it will reduce corrosion, line losses, flow stoppages.

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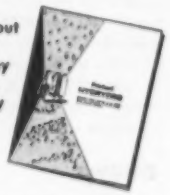
To find out all about HYDRYERs . . . and the many ways they can benefit you . . . write for your copy of Prichard's new HYDRYER bulletin, No. 16.0.081.



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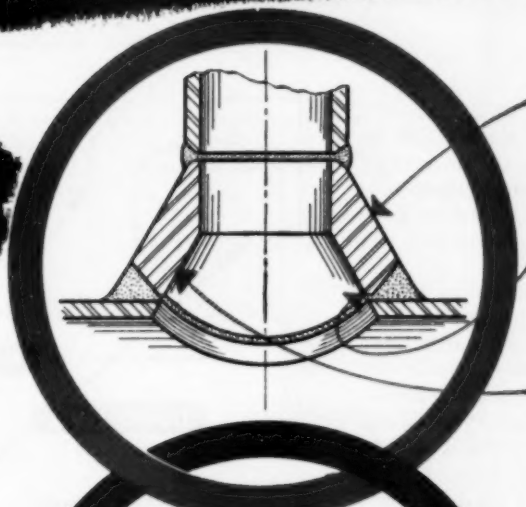
COOLING TOWERS • SPECIALIZED HEAT EXCHANGERS • GAS & AIR TREATING EQUIPMENT

Engineered Reinforcement Against CORROSIVE ATTACK at Branch Connections

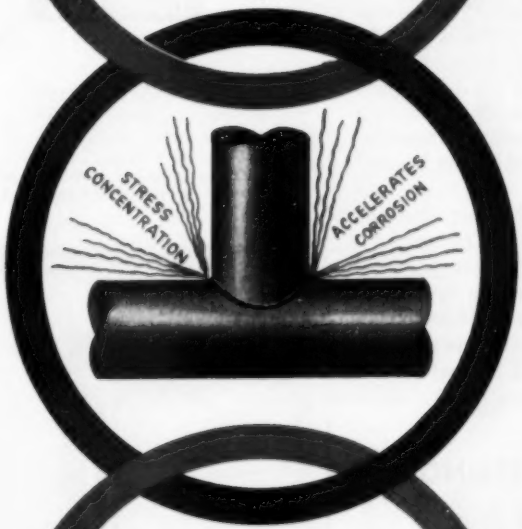


Designed with thick, tapered section to relieve stress concentration.

Additional metal prevents branch connection from corroding dangerously thin.

Funneled inlet relieves stress concentration at point of highest magnitude—the *inside* of the crotch.

Accelerated corrosion due to stress concentrations can be readily eliminated . . . by using WELDOLET WELDING FITTINGS at all 90° branch connections.



When corrosion exists in a piping system, it attacks the points of stress concentration most severely. WHY DOWN-RATE YOUR PIPING SYSTEM BECAUSE OF THIS WEAK LINK?

SPECIFY AND USE . . . . . . BONNEY WELDOLET WELDING FITTINGS to insure 100% pipe strength at branch connections under corrosive conditions.

WeldOlets, butt-welding

ThredOlets

WeldOlets, socket-welding

FOR COMPLETE ENGINEERING DATA WRITE FOR YOUR BONNEY W-3 CATALOG

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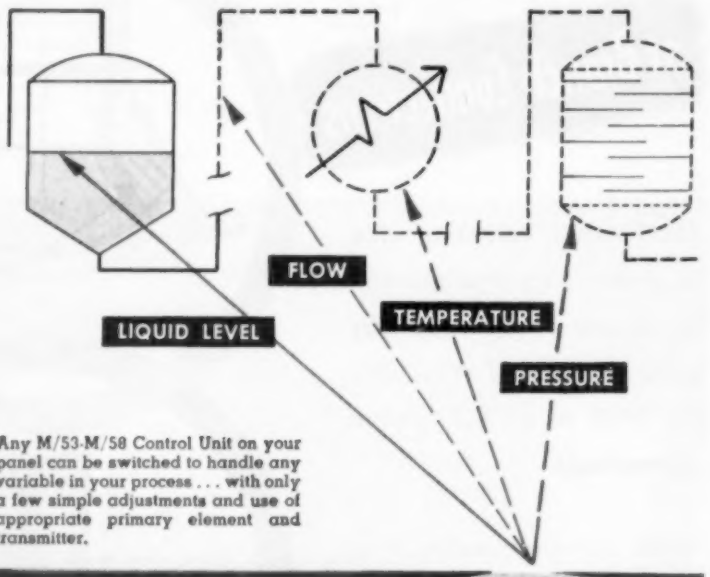
ALLENTOWN, PENNSYLVANIA

No obsolescence for this controller when process requirements change!

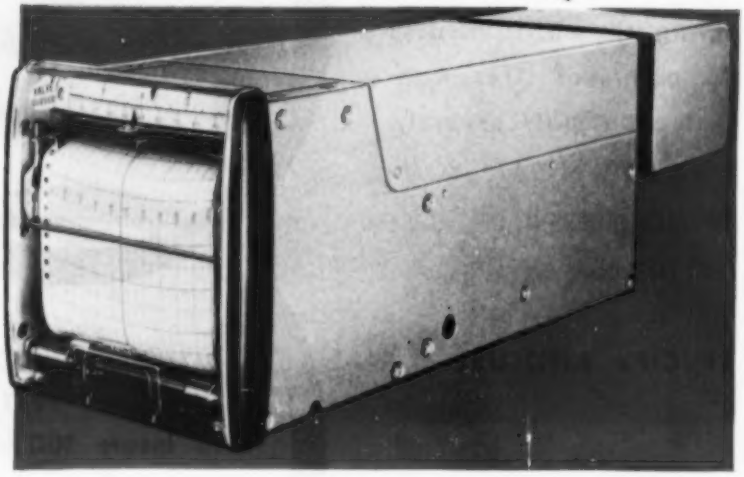
That's right! The Foxboro M/53-M/58 Recorder-Controller is a "universal" instrument, equally adaptable to any process measurement — whether flow, temperature, pressure, liquid level, or other.

All it takes is connection to the proper measurement transmitter having a 3-15 psi pneumatic signal . . . and making the appropriate controller settings. Changes such as adding derivative to reset or proportional control can be made *on the job* without special tools or realignments. You save needless duplication in capital investment . . . save time and trouble in making process revamps . . . and get the unsurpassed performance of M/58 control on every application!

Whether you favor graphic, console, or conventional mounting, you can cut instrument overhead at every stage, step-up efficiency in every operation, with the Foxboro M/53-M/58 Recorder-Controller. Write for complete information. **The Foxboro Company, 748 Neponset Ave., Foxboro, Mass., U.S.A.**



Any M/53-M/58 Control Unit on your panel can be switched to handle any variable in your process . . . with only a few simple adjustments and use of appropriate primary element and transmitter.



OTHER BASIC ECONOMIES

- **Simplified Ordering**
  —complex specification sheets are eliminated.
- **Reduced Stock Inventory**
  —only one type recorder-controller for all control jobs.
- **Reduced Maintenance**
  —fewest parts, rugged design, no diaphragms, highest quality throughout.

FOXBORO
REG. U.S. PAT. OFF.

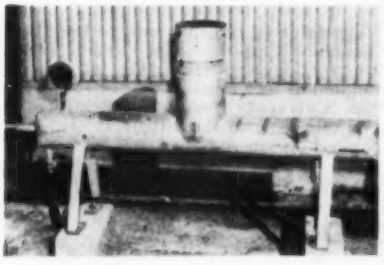
Consotrol Process Control

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

the chemical sump is simple and quickly done. There is no upkeep to this housing, which adds years to the life of the pump.

Easily Made Stand Can Keep Tools Convenient

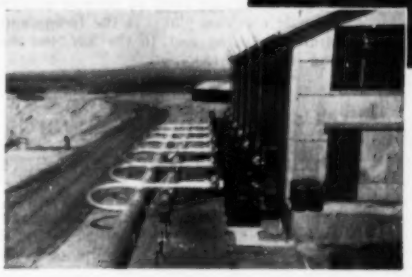
The portable tool stand shown in the photograph has three claims to fame: easy to build, convenient to use, and easy to move about. The rack is constructed of scrap sheet metal, and is equipped with handles on either end. The shelf arrangement provides for convenient segregation of tools and parts, although the illustration doesn't show that the owners took full advantage of this feature!



Little Ingenuity Builds Efficient Valve Tester

The picture shows the results of a little ingenuity in shop fabricating—a highly efficient valve tester. A 10-foot section of 8-inch pipe is supported horizontally on sheet metal legs bolted to 6-inch squares of concrete. The vertical section, constructed of 12-inch pipe, is topped with a bushing into which the valve is screwed. The air used for testing is brought in through ¾-inch pipe and is adequately fitted with valves for a secure regulation. The pressure gage is mounted on the horizontal section of pipe. A small bleed valve extends downward from the test unit and is used to remove moisture. This can be inexpensively built for perhaps $25.

OVER 1,000
UNIT INSTALLATIONS ARE:
Proven Insurance



BURGESS-MANNING
Pulsation Snubbers

Stop Pulsation

Pulsation is dangerous and costly in any plant pumping gas. Designers and operators of hundreds of plants have called on Burgess-Manning Engineers to design gas pulsation snubbers to *STOP PULSATION* in their operation. Here's the record: Piping failure was eliminated. Gas flow improved for accurate measurement. Downtime eliminated. Less costly piping was installed. Smoother and more efficient equipment operation.

Stop gas pulsation in new plants or eliminate it in existing plants by calling on Burgess-Manning Engineers. Send for performance data today!

BURGESS-MANNING COMPANY
1203 DRAGON STREET
DALLAS, TEXAS
Sound Engineering
LIBERTYVILLE, ILL.
CHICAGO, ILL.

For more data on advertised products, use Readers' Service Cards, last page.

Who's Building. . .

PUERTO RICO'S BIGGEST

Continued from Page 83

years Saacke has been associated in an executive capacity with Davison Chemical Company and, prior to that, was with The M. W. Kellogg Company.

Associated with Admiral Carter in the organization of Commonwealth Oil are F. H. Gilbert and E. M. Carey, of New England Petroleum Company, which will purchase some of the products.

Group Studying Plans to Build Butadiene Plant

A new corporation, Texas Butadiene & Chemical Corporation, has been formed for the purpose of developing plans for the construction of a combination butadiene and alkylation plant in the Houston area.

Participants in the development of plans for the concern are Warren Petroleum Corporation, The Fluor Corporation, Ltd., William R. Staatz & Company, Wertheim & Company and Carl M. Loeb Rhoades & Company. Dr. Robert L. Purvin, of the Dallas consulting engineering firm of Purvin & Gertz, has been named president of the new organization.

Plans for the proposed plant are to be worked out over the next couple of months.

Texas Gulf Starts Work on West Texas Gasoline Plant

Construction has started on Texas Gulf Producing Company's $1,750,000 gasoline plant at the north end of the Headlee field in Ector County, West Texas, about four miles from Odessa.

C. F. Braun & Company, Alhambra, Calif., is doing the design engineering, equipment purchasing and inspection, while O. L. Olsen & Company, Houston, is doing the construction. Completion of the facility is scheduled for December.

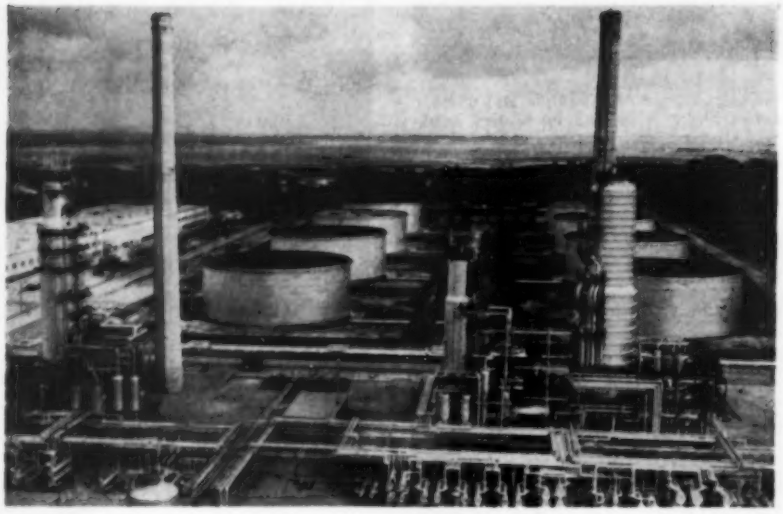
Present design capacity for the plant is 15 Mmcf of natural gas a day. At design capacity the plant will produce about 12.5 Mmcf a day of residue gas and about 1400 barrels of an "unfractionated" LPG-gasoline product. Design and engineering for the plant provide for future expansion to 35 Mmcf of gas daily.

Ashland Awards Contract On New Houdriformer Unit

Catalytic Construction Company has been awarded a contract for the design and procurement and construction of a new 6000-barrel-a-day Houdriformer unit and prefractionation section for Ashland Oil & Refining Company.

The new Houdriformer, to be built at Ashland's Number Two refinery at Catlettsburg, Ky., will be designed to take a full range of naphtha charge for upgrading motor gasoline.

Work on the project is now under way and is expected to be completed in approximately 11 months.



Shell's New Refinery at Fawley—

Part of the new Shell oil refinery at Fawley, in Southern England, is seen from the top of the catalytic cracking plant. In the foreground are the distillation units, behind them is the administration building and, to the left, the maintenance building, believed to be the largest of its kind in the world.

Avtane Refining Awards Design Contract to Tears

Tears Engineers, Dallas, Texas, has been awarded the process design contract for the 10,000-barrel-a-day refinery to be built at Freeport, Texas, by Avtane Refining Company.

Negotiations are still under way for a site and for a construction contract. Construction is scheduled to start before the end of the year and expected to be completed by mid-July, 1955.

Design calls for the following process units: 10,000-barrel-a-day crude topping, 5000-barrel-a-day vacuum distillation, 2000-barrel-a-day catalytic reforming, 4000-barrel-a-day (fresh feed) catalytic cracking unit, and isomerization, dehydrogenation and alkylation units. Types of catalytic reforming and cracking units have not been decided.

B-A Will Start Soon on Cat Reformer Building

Installation of a catalytic reformer at its 7200-barrel-a-day Calgary, Alta., Canada, refinery has been scheduled for the near future by The British American Oil Company, Ltd.

Purpose of the unit will be to increase the octane rating of the company's gasolines. It will be able to process about 2000 barrels a day of straight-run gasoline, or a mixture of straight-run and thermally cracked gasoline.

The catalytic reformer will be built by The Fluor Corporation of Canada, Ltd. Construction will start this fall, with completion scheduled for February, 1955. Estimated cost of the process plant, together with British-American's required off-site facilities, is $725,000.

Write-Off Extension

A proposal to extend rapid tax write-off benefits to plant modernizations instead of limiting them to new or enlarged facilities has apparently been shelved by the Office of Defense Mobilization.

An ODM official reports that the plan to include modernizations is "still under consideration" but that it has been in such a state for several months and has made no progress. ODM, meanwhile, is continuing its old policy of turning down applications where replacement, rather than expansion, is involved. Probable reason for the delay is that extention of the write-off benefits now would bring a corresponding drop in government revenues.

Many applications for fast tax write-offs, however, are being approved. Largest grant last month went to Sun Oil Company on two major expansion projects costing a total of almost $16.5 million.

Sun's plans include construction of a 27,000-barrel-a-day catalytic cracking unit and related facilities at the company's Toledo, Ohio, refinery. ODM allowed the company to write off 25 percent of $5,883,800 and 50 percent of $676,200.

Sun's other project is a catalytic cracking unit, modification of a combination unit and gas plant and installation of related facilities at its Marcus Hook, Pa., refinery. Write-off rate will apply to 35 percent of 8,983,800 and 50 percent of $926,200.

Other projects approved by ODM for fast write-offs, with location, facility, total cost and the amount certified, were:

Sinclair Refining Company—East Chicago, Ind., construction of a 16,000-barrel-a-day catalytic reforming unit and

EASTERN STATES PETROLEUM CO., INC.
6936 MANCHESTER AVENUE
P. O. BOX 6008 - HARRISBURG STATION
HOUSTON 12, TEXAS

HOUSTON PHONE
WEntworth 1651
CABLE ADDRESS
"EASTAPET"
HOUSTON, TEXAS

RICHARD B. KAHLE
PRESIDENT

March 16, 1954

Mr. George R. Brown
Executive Vice President
Brown & Root, Inc.
P. O. Box 3
Houston 1, Texas

Dear Mr. Brown:

The rehabilitation of our alkylation unit and its conversion from hydrofluoric to sulfuric catalyst type was completed by your people last month and put into immediate operation. The work was finished in a hundred and one working days from the date you were given the contract.

This work, I believe, sets a record in two cases: first, in time of completion; and, second, in the fact that the plant started up immediately on completion, was gradually brought up to capacity, is running at more than designed capacity, is running at full designed specifications and has required no substantial change of the equipment as completed.

As I told you shortly after this job began, it was of great importance for us to finish it promptly and have it in operation at full capacity immediately upon completion. You personally stated that you would do everything you could to expedite the completion and that it would be a good job. You have certainly complied in both instances.

I want to thank you personally, and for my associates in the company, on the job you did for us and I wish you would convey to your associates who worked on this construction, our grateful appreciation and thanks.

Sincerely yours,

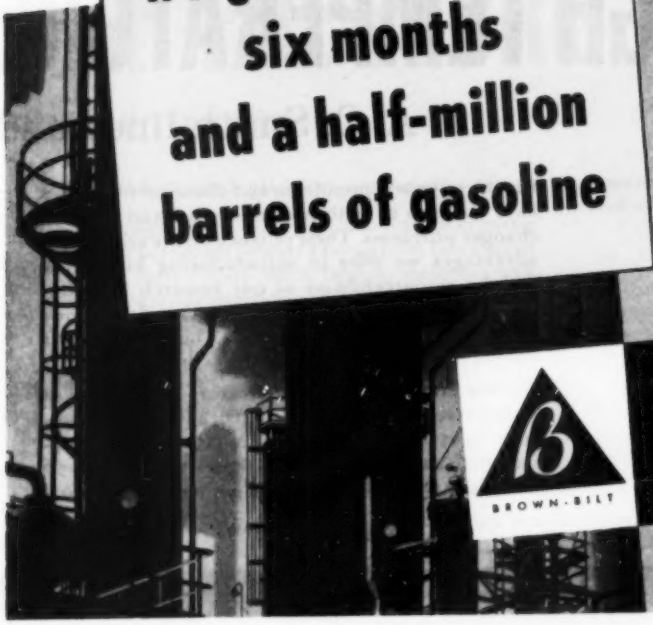
R. B. Kahle

we gave them back six months and a half-million barrels of gasoline

The new Eastern States Petroleum Company's aviation gasoline refining unit chalked up another rapid completion for Brown & Root. The plant was finished in the record time of 101 working days . . . cutting more than six months off normal construction time.

Early completion of a project means a bonus of unexpected production which, in the final analysis, represents a gratifying reduction in plant cost.

If your organization plans construction, contact Brown & Root. Planning experts will be put at your disposal . . . no obligation, of course.



BROWN-BILT

BROWN & ROOT, INC.
Engineers • Constructors
CABLE ADDRESS - BROWNBILT
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BROWN ROOT de MEXICO, S.A. de C.V., Mexico City, Mexico
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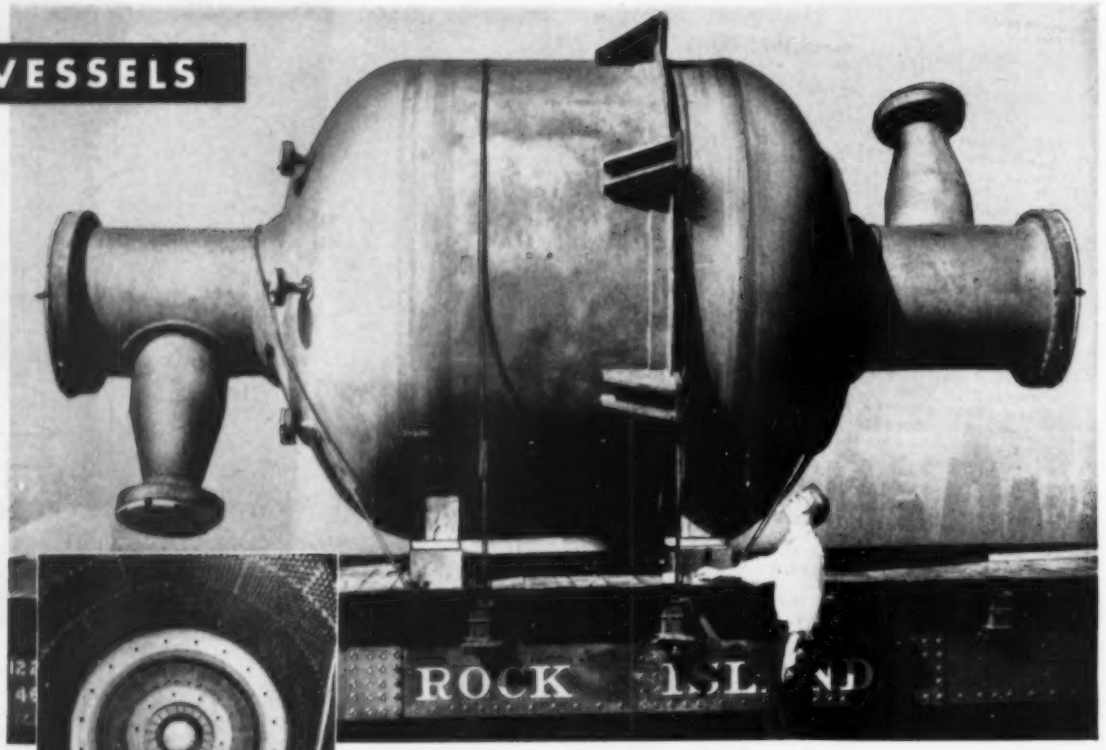
BROWN & ROOT, LTD., Edmonton, Alberta, Canada
BROWN & ROOT, S. A., Panama City, Panama

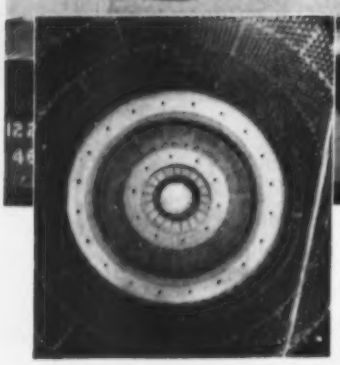
For more data on advertised products, use Readers' Service Cards, last page.

A.O.Smith for

VESSELS



Refractory-lined reactor ready for shipment from the Milwaukee plant. Overall length, flange-face to flange-face: 21 ft. 7 in. Three of these A. O. Smith reactors, when installed, become the heart of a catalytic reforming plant.



These interior views show, *at top* expanded metal liner support prior to gunniting insulation. Grid platform support rings are visible. *Lower picture* shows shop-installed refractory lining covered by stainless steel lining designed with interlocking expansion joints.

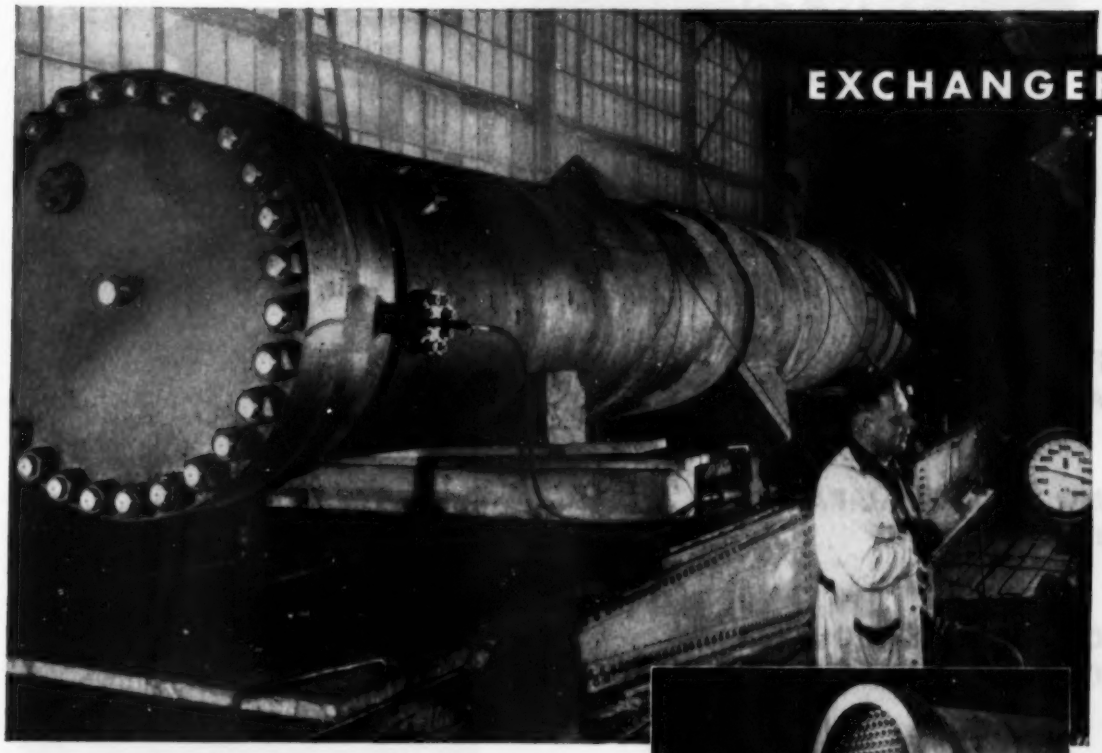
HIGH TEMPERATURE

A. O. Smith lined and

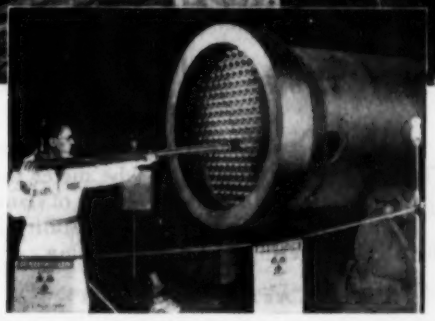
For thirty years, petroleum and chemical industries have come to us with pressure vessel and heat exchanger problems. Their reliance on the unmatched advantages we offer in manufacturing know-how and the resourcefulness of our research laboratories and technicians, design engineers and shop men has proved to be well placed. The two reactors shown here are examples of our work.

On this page is a special, refractory-lined vessel of A-212 steel, designed for 650 psi. and temperatures starting at 900° F. The walls are protected by shop-installed refractory lining. Total weight of 50 tons includes 28,000 lb. of lining, its supports

Outstanding Advantages



Shown here is one of twenty poly reactors going through our heat exchanger shop, undergoing tube side pressure test at 2160 psi. One-quarter inch wall tubes are welded to tube sheets and tubes rolled full depth on all poly reactors.



Radioactive cobalt being used for examination of welds during poly reactor construction. This method permits examining welds that are inaccessible to X-ray equipment.

HIGH PRESSURE

tubular reactors

and a catalyst grid platform on pedestal rings.

On this page is shown a poly reactor undergoing shop tests before shipment. Throughout fabrication and long before shop work begins, materials and processes are subjected to exhaustive tests to make sure quality demands are met. Metallurgical, spectrographic and pressure tests during and at completion of construction assure conformity to specifications.

YOU ARE INVITED

Whenever you have a pressure vessel or exchanger problem, write our Milwaukee office for information about the outstanding advantages which A. O. Smith research, engineering and construction offer.

Through research A.O. Smith *... a better way*

A.O.Smith
CORPORATION

Process Equipment Division
International Division: Milwaukee 1
MILWAUKEE • HOUSTON • LOS ANGELES

For glass-lined process equipment, contact GLASCOTE PRODUCTS, INC., Cleveland 17, Ohio—A new A. O. Smith Subsidiary

For more data on advertised products, use Readers' Service Cards, last page.

10 years of research . . . over 75 years of pump manufacturing experience . . .

THE NEW PATENTED HILLS-McCANNAMETER "the meter that pumps . . ."

A. POSITIVE DISPLACEMENT METERING

. . . plus

B. NO FRICTIONAL PARTS IN LIQUID END

. . . plus

C. CONTINUOUS FLOW CHARACTERISTICS

The Hills-McCannameter—"the meter that pumps"—establishes an entirely new set of standards for precision, accuracy and reliability in small volume metering and proportioning.

SPECIFICATIONS—Series "A"

Effective capacity range: 5 c.c. to 6 gal. per hr.
Standard pressure range: to 2500 psi (special designs to 10,000 psi).

If you have been looking for a pump that will *precisely* meter a wide output range of small volume flows, here is the answer. Write today. HILLS-McCANNA CO., 2441 W. Nelson St., Chicago 18, Illinois.

Check and compare with any other pump

- No stuffing boxes
- High speed, self cleansing valves
- Hydraulically balanced
- Stepless volume control
- Automatic vapor venting
- Downhill* metering

*From high suction to lower discharge pressure.

See *the* ***Hills-McCannameter*** *in action at the Instrument Show, Sept. 14-24. Tickets for the demonstrations can be secured at Booth 101.*

HILLS-McCANNA

metering and proportioning pumps

Also Manufacturers of

SAUNDERS PATENT DIAPHRAGM VALVES • FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS

Who's Building...

related auxiliaries at its refinery there, $12.8 million: $8.2 million for basic facilities at 65 percent and $4.1 million for auxiliary equipment at 45 percent. In addition, Sinclair will spend $500,000 on buildings, on which normal depreciation will apply.

The Texas Company—West Tulsa, Okla., construction of a 9040-barrel-a-day catalytic reforming unit and other facilities at its refinery there, $6,900,000: $4,467,000 at 65 percent; $2,400,000 at 50 percent, and $33,000 at 15 percent.

Standard Oil Company (Indiana)—Wood River, Ill., construction of an 8000-barrel-a-day coking unit and auxiliary facilities at its refinery there, $3 million: $2,439,000 for basic refining facilities at 30 percent; $546,000 for auxiliary facilities at 45 percent, and $15,000 for buildings at 15 percent.

Utah Oil Refining Company—Salt Lake City, construction of a 750-barrel-a-day phosphoric acid catalytic polymerization unit, $212,130: $205,025 at 65 percent, and $7,105 at 40 percent.

Columbia-Southern Begins Work on Ammonia Unit

Construction is now under way on a $3 million ammonia plant being built by Columbia-Southern Chemical Corporation at Natrium, W. Va. The new plant will mark the entry of Columbia-Southern into the ammonia production field.

Design and construction of the plant is under the supervision of Chemical Construction Company. The plant is expected to be in production by April of next year.

Consolidated Carbon Plans Ten Carbon Black Plants

Construction of ten carbon plants using a new manufacturing process developed by Rice P. Lynn, president of Lynn Carbon Black Company, is planned by Consolidated Carbon Corporation of Illinois. Sites of the proposed facilities have not been disclosed.

Dr. W. H. Balka, Dallas consulting engineer and vice president of Lynn Carbon Black, will handle plant design for Consolidated. It is claimed that the new process can use either natural gas or oil as feed and is smokeless and air-cooled.

Monsanto of England Plans Maleic Anhydride Plant

Work is scheduled to start soon on a plant Monsanto Chemicals, Ltd., London, will build to produce maleic anhydride by direct oxidation of benzene. The plant will be constructed at Ruabon, North Wales. Capacity of the planned installation has not been announced.

Union Oil Starts Up Northwest Lube Oil Plant

The Northwest's most modern lubricating oil compounding and blending plant has been placed in operation at

an ACCO product

ACCO Registered* WIRE ROPE SLINGS

A STANDARD OF QUALITY

●"ACCO *Registered*" is the registered trademark applied by American Chain and Cable Company to slings of the highest grade, but it is more than just a trademark.

"ACCO *Registered*" is a definite specification of quality in both material and design.

To be "ACCO *Registered*," a wire rope sling must meet the following specifications:

1. **It must be made from high strength "Green Strand" wire rope.**
2. **All parts of the finished sling must have a breaking strength equal to the catalog strength of the sling body.**
3. **All fittings and attachments must withstand a proof-test equal to at least two times the rated capacity without permanent distortion.**
4. **Actual field service tests of each design.**

As evidence of compliance with these requirements each sling is given a metal identification tag and is accompanied by a Certificate of Proof Test and Registry.

What does ACCO REGISTRY mean to you?

It means that you can equip your shop with "lifting tools" and be confident that their designs and materials are specifically selected for the highest efficiency by trained engineers who spend all their time on slings.

It means that you can be sure that your men, materials, and machines are given the highest protection against injury during lifting operations.

Where can you get ACCO REGISTERED SLINGS?

To make ACCO *Registered* Slings immediately available for your requirements, American Chain and Cable Company, Inc. has appointed one of the best industrial supply houses in your community as an ACCO *Registered* Sling distributor. Selection for such appointment is made on the basis of the distributor's desire to serve you, his grasp of your problems, and his willingness to maintain in his stock sizes and types of slings you need.

See your ACCO *Registered* Distributor or write to us for literature and his name.

*Trademark Registered

ACCO Wire Rope Sling Department
AMERICAN CHAIN & CABLE

Wilkes-Barre, Pa., Atlanta, Chicago, Denver, Houston, Los Angeles, New York, Odessa, Tex., Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Bridgeport, Conn.
In Canada: Dominion Chain Company Ltd., Niagara Falls, Ont.

Links Shackles Hooks

For more data on advertised products, use Readers' Service Cards, last page.

"Varec"
PULSE CODE
TELEMETERING SYSTEM
(PATENTS APPLIED FOR)

THE MOST MODERN DEVELOPMENT IN LIQUID LEVEL TELEMETERING!

SEE PULSE CODE AT THE INSTRUMENTS SHOW IN PHILADELPHIA, SEPT. 15-21 BOOTHS: 757, 759, 761

The Vapor Recovery Systems Company, through years of research and development, has continuously improved remote liquid level gauging methods. Development has progressed from the single remote receiver unit to the more complex systems involving multiple tank farms and simultaneous readings at two or more points. Being well aware that the petroleum and chemical industries would one day demand much longer transmission distances, with even greater accuracy and dependability under all conditions, VAREC conducted an extensive study of the problems involved. Many systems were built and tested exhaustively. Finally, the desirable features of each were combined into one system that provides the stability, accuracy and reliability required by the users – a liquid level remote gauging system that is extremely flexible in application, with distances limited only by available communication facilities. Vapor Recovery Systems Co. is proud to offer this new PULSE CODE telemetering system – the most modern development in remote gauging. Write for additional information.

PULSE CODE RECEIVER

"Varec"
THE VAPOR RECOVERY SYSTEMS CO.
COMPTON, CALIFORNIA
Cable Address: VAREC COMPTON
(Cal. U.S.A.) All Codes
961-1

Who's Building . . .

Portland, Ore., by Union Oil Company of California.

Completed at a cost of $450,000, the new plant will compound, blend, can and package between 6 and 8 million gallons of lubricating oils and greases when operating at full capacity.

New Nylon Unit Operating—

Checking a bobbin of nylon produced at The Chemstrand Corporation's new wholly integrated nylon plant at Pensacola, Fla., are Henry H. Bitler, president of Chemstrand, left, and Roy G. Hemminghaus, vice president manager of the new plant. First wholly integrated nylon manufacturing facility in the U. S., the new 50 million-pound-a-year plant has been under construction for the past three years. E. I. du Pont de Nemours & Company, Inc., designed and constructed the new facilities.

Aramco Begins Work on Ras Tanura Hydroformer

Construction of a fluid hydroformer, the third of a series of plants designed to improve the octane rating of gasoline refined by Arabian American Oil Company, has begun at the company's Ras Tanura refinery.

Scheduled for completion by July 1, 1955, the hydroformer will be integrated with the catalytic polymerization plant, which was completed in September of last year, and the light straight-run caustic wash plant, completed in March of this year.

The three units will represent a capital outlay of about $15 million. Ultimate cost of the hydroformer, most important of the three plants, has been estimated at $12,750,000.

Engineering for the hydroformer plant is being done in London by Lummus Company, Ltd., under the direction of Aramco engineers.

Indiana Standard to Build New Rocket Fuels Plant

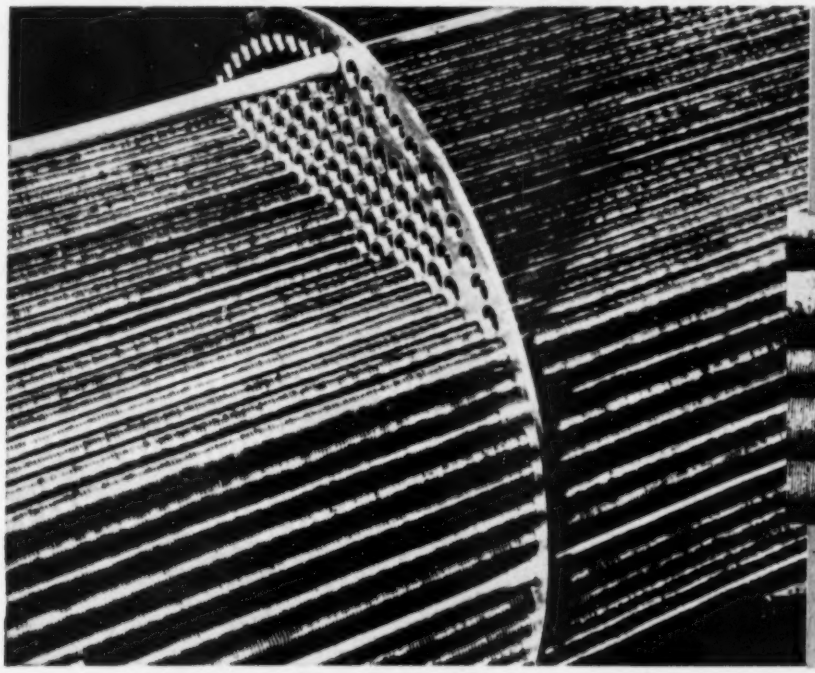
Standard Oil Company (Indiana) has signed contracts with the U. S. Air Force to build and operate a pilot plant for certain new types of solid rocket propellants at Seymour, Ind.

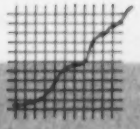
Standard will build and operate the plant for the Wright Air Development Center, Air Research and Development Command. Construction is expected to start within the next two months on a 156-acre tract at the northwest corner

How RETUBING WITH Wolverine Trufin*
TYPE S/T

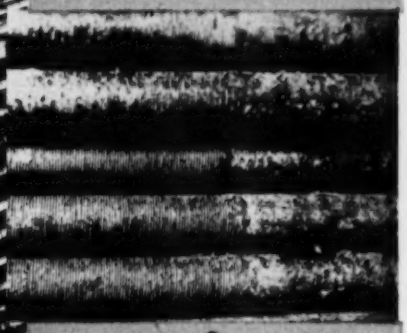
BOOSTED CONDENSING CAPACITY

at AURORA GASOLINE COMPANY





A typical Trufin Type S/T bundle similar to the one used at Aurora to condense straight-run gasoline from a crude fractionating tower.



Note unretouched photo comparing fouling and scaling of Trufin versus prime surface tubing after one year's service.

Increased production of an existing "stand-by" condenser at Aurora Gasoline Company, Detroit, Michigan called for the installation of additional condensing surface area. The stand-by unit—a small, prime-surface tube unit—was not originally designed for this kind of service.

Wolverine's Field Engineering Service suggested that the smaller condenser be retubed with Trufin Type S/T . . . an integral finned tube designed primarily for shell and tube units. Trufin was a natural choice simply because it packs so much condensing surface in a small area.

As a result, the stand-by unit—when retubed with Trufin—operated at the same heat duty as the larger prime-surface condenser originally designed for this service.

Full advantages of Wolverine Trufin are realized in units like Aurora's. When additional capacity or increased surface area is required—where costs must be reduced—Trufin can do an outstanding job.

Remember: Trufin is all one piece! Fins are extruded right from the tube wall. Trufin stands up under the shock of vibration, temperature changes, and pressures.

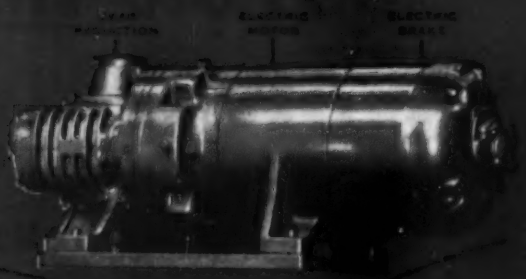
WHAT ABOUT YOU? If you have an under-surfaced heat exchanger—one that requires a bigger punch—you'd do best to consider Trufin, too. It's available in copper, inhibited admiralty, copper-base alloys, aluminum, stainless steel, electric welded steel, bi-metal. Write for your copy of Wolverine's Condenser Tube Book today! WOLVERINE TUBE DIVISION of Calumet & Hecla, Inc., 1437 Central Avenue, Detroit 9, Michigan.

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

*REG. U.S. PAT. OFF.

WOLVERINE TUBE
DIVISION OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES
EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK.

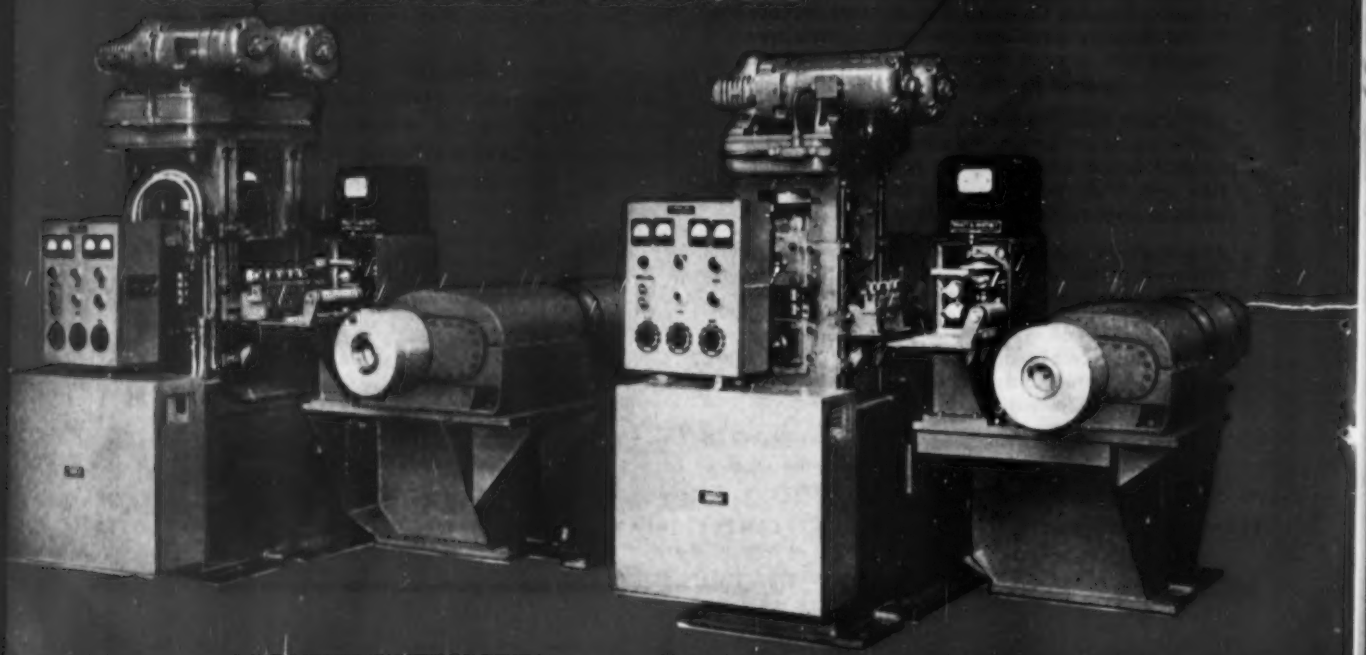


See how easily the standard electric motor, standard gear reduction, standard electric brake combine into a drive that gives the RIGHT horsepower, the RIGHT shaft speed, the RIGHT features . . . all in one compact unit. Nowhere else will you find power units that are so flexible, so easily adaptable, and in such a wide range of types and ratings.

Master power drives are available in thousands and thousands of ratings (1/8 to 400 HP) . . . in open, enclosed, splash proof, fan cooled, explosion proof . . . horizontal or vertical . . . for all phases, voltages and frequencies . . . in single speed, multi-speed and variable speed types . . . with or without flanges or other special features . . . with 5 types of gear reduction up to 430 to 1 ratio . . . with electric brakes . . . with fluid-drive . . . with mechanical or electronic variable speed units . . . and for every type of mounting . . . Master has them all and so can be completely impartial in helping you select the one best power drive for you.

standard units easily combine into special purpose drives

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO



of Freeman Field, a World War II Air Force base at the southwest edge of Seymour. The plant is expected to be completed and in operation this fall.

California Standard Will Install Recovery System

Standard Oil Company of California has appropriated $40,000 for the first vapor recovery system to be installed on tank truck loading facilities in the Los Angeles Air Pollution District.

The new facilities, not presently compulsory under the APD's smog abatement regulations, are being voluntarily installed at the company's Clearwater terminal, probably within 60 days.

The new recovery system seals off the point of contact between loading hose and tank trucks and draws off all hydrocarbon vapors which might otherwise escape into the air during loading operations. Standard to date has spent an estimated $6 million for equipment designed to prevent emission of noxious fumes into the atmosphere.

Lion Adding Dry Ice Unit To New Barton Facility

Lion Oil Company is building a new dry ice plant at its new Barton plant, located on the west bank of the Mississippi River in St. Charles Parish, La. The plant will make use of a portion of the stream of high purity carbon dioxide produced as a by-product at its Barton plant. Lion gets the stream by using The Girdler Company's Girbotol process for purifying raw ammonia synthesis gas.

The dry ice plant is being engineered and erected by Girdler, and is expected to be completed this month.

Conoco Raises Capacity On Lake Charles Refinery

An expansion and modernization program which boosts the capacity of Continental Oil Company's Lake Charles, La., refinery to 45,000 barrels a day has been completed. The new capacity is four and one-half times the refinery's original thruput.

Units added to the plant include a new atmospheric crude topping unit, which, though designed to process 30,000 barrels a day, has been operated at a capacity of 38,000 barrels a day. Also new at the refinery are two Thermofor catalytic cracking units and a catalytic reforming unit. In addition, the company has modified an original topping unit, increasing its capacity from 12,000 to 16,000 barrels a day.

For technical details see page 119.

Tide Water Awards Braun Contract on New Refinery

C. F. Braun & Company, Alhambra, Calif., has been awarded an engineering contract for the new 100,000-barrel-a-day refinery Tide Water Associated Oil Company will build somewhere on the Eastern Seaboard.

So far the site of the new refinery has not been chosen, although several are

Standardaire® Blowers

offer constant and dependable service year in and year out

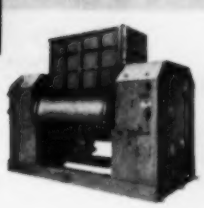
The *Standardaire* Blower is designed and service tested for high speed operation. The *Standardaire* employs a proved principle of compressing air on a modified adiabatic cycle with lower mean internal pressure. This permits the *Standardaire* to discharge the greatest output per pound of weight ever achieved in this type blower. *Standardaire's* symmetrical, cycloidal rotors act as an air screw. The air is taken in and discharged smoothly from pockets which form between the rotors. The compression is gradual and free from shock resulting in a lower decibel rating than for comparable units of other positive displacement types.

Get further information on the *Standardaire's* application to the petroleum industry. Write today:

READ STANDARD
CORPORATION

BLOWER-STOKER DIVISION
370 Lexington Avenue
New York 17, New York

Read Standard also manufactures a complete line of chemical mixers for laboratory and industrial use. For information write, Read Standard Corp., York, Pa.



For more data on advertised products, use Readers' Service Cards, last page.

DUAL METAL

What is "dual metal"? *Depends on what business you're in!*

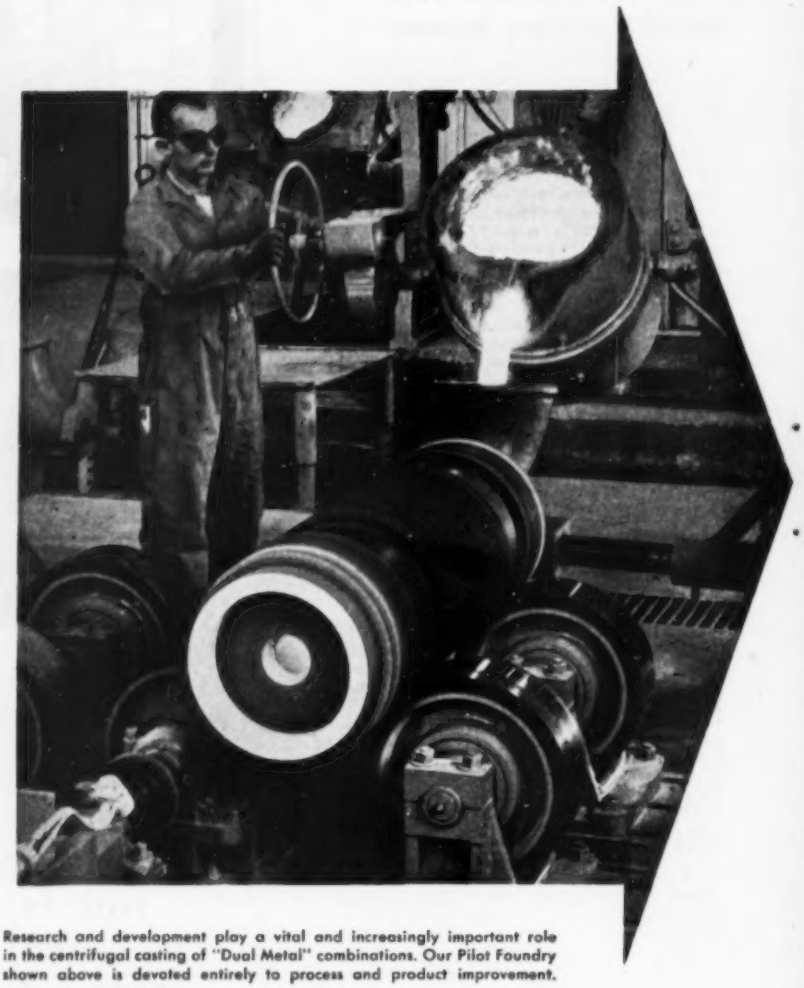
To twenty of America's largest basic industries with problems of abrasion or corrosion—or both—"Dual Metal" means U. S. Pipe's Special Products Division.

Specifically, "Dual Metal" is our name for centrifugally cast cylindrical sections in which two dissimilar metals are bonded metallurgically by centrifugal force and temperature.

"Dual Metal" centrifugally cast, integrally fused combinations of two dissimilar metals are doing industry's most difficult and exacting jobs better and more economically than ever before.

Design engineers have been quick to recognize the outstanding merits of a process capable of combining the desired mechanical and chemical properties no single metal possesses.

"Dual Metal" means versatility, efficiency and economy.



Research and development play a vital and increasingly important role in the centrifugal casting of "Dual Metal" combinations. Our Pilot Foundry shown above is devoted entirely to process and product improvement.

UNITED STATES PIPE & FOUNDRY CO.

Special Products Division

BURLINGTON, NEW JERSEY

SALES OFFICES: LOS ANGELES, CHICAGO, ST. LOUIS, CLEVELAND, DETROIT, PITTSBURGH, BURLINGTON

NEW ANSWER TO AN OLD REFINING PROBLEM

less abrasion...longer wear

"Dual Metal" solves one of the petroleum industry's most severe and costly problems—catalyst erosion of lift pipe and catalyst handling lines.

In making a "Dual Metal" lift pipe the outer shell of weldable alloy steel is poured into a rapidly rotating mold. The abrasion-resistant alloy iron core is centrifugally fused to the spinning shell. At the proper time and temperature, the result? A metallurgically bonded two-metal structure that combines the strength and weldability of low alloy steel and the superior abrasion resistance of alloy iron.

"Dual Metal" lift pipes now in use in 35 of the nation's leading refineries show encouraging evidence of much longer life. In one typical refinery periodic examinations of high temperature catalyst pipes have indicated abrasion resistance of better than 16 to 1 over conventional steel piping. A once-troublesome bottleneck in processing has been eliminated and refinery operations made more efficient and economical.

Perhaps this versatile product is the answer to your particular problem. Write today for specific literature and information on "Dual Metal" applications for the refining industry.

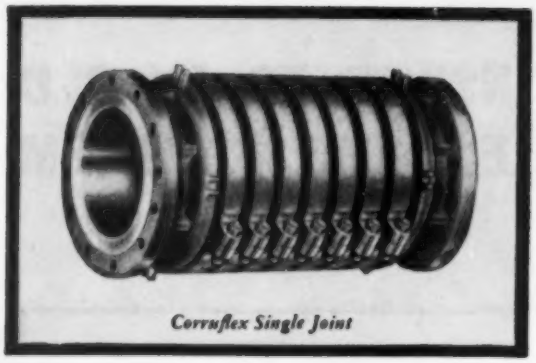
"DUAL METAL" CENTRIFUGAL CASTINGS

SIZE RANGES

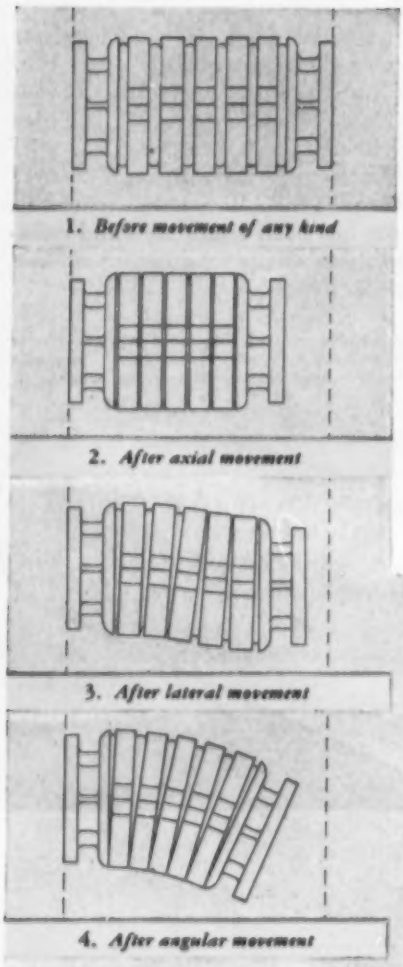
Outside Diameter	6" to 36"
Wall Thickness	½" and up
Length	Up to 14' without welding

Typical Oil Industry Applications: Catalyst Lift Pipe, Depressurizing Pipe, Catalyst Transfer Lines, Slush Pump Liners, Valve Nozzles, etc.

INSTALL...
AND THEN FORGET
Corruflex PACKLESS EXPANSION JOINTS



Corruflex Single Joint



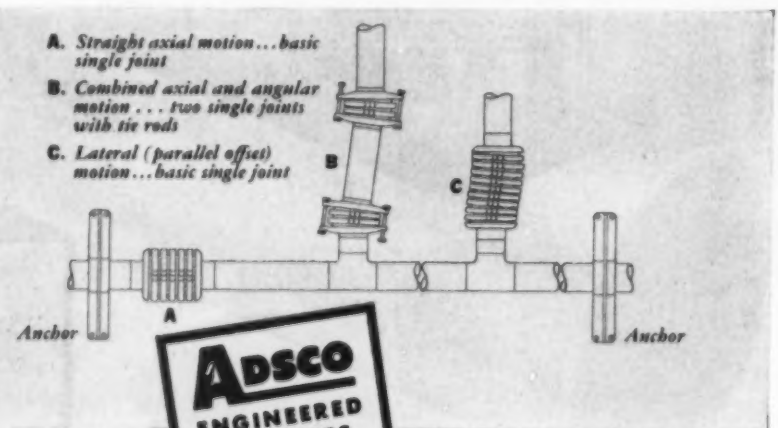
1. *Before movement of any kind*
2. *After axial movement*
3. *After lateral movement*
4. *After angular movement*

Why worry about maintenance in pipe lines when you don't have to? Install ADSCO Corruflex Expansion Joints... they are packless and require no maintenance. Put 'em in the line and forget 'em.

In ADSCO's *complete* Corruflex line there are many joints for many purposes: Swing, Hinge, Tie-Rod, Universal, Internally-Guided, Anti-Compression, Balanced, Gimbal, etc. But the leader of the Corruflex line.. the joint from which all others are derived...is the Basic Single Joint shown on this page. Here is a dependable workhorse which will solve many pipe expansion problems. Problems *it* can't solve *can* be solved by other Corruflex Joints.

Drawings 1 & 2 at left show accordion-like movement as the Basic Single Joint opens and closes to absorb axial movement. In Drawings 3 & 4, note that maximum lateral deflection and maximum angular rotation are obtained when joint is in median position. ADSCO can supply complete tabular data on the maximum amount of allowable lateral and angular movement either side of center line. Under certain conditions, such as the addition of extra corrugations, the Basic Single Joint can be used to absorb combined axial and lateral or combined axial and angular motions.

For assistance in laying out piping systems, a cordial invitation is extended to you to consult ADSCO's engineering staff. Phone your ADSCO representative about this service or write the factory direct.


A. Straight axial motion... basic single joint
B. Combined axial and angular motion . . . two single joints with tie rods
C. Lateral (parallel offset) motion... basic single joint
B
C
A
Anchor
Anchor

ADSCO ENGINEERED PRODUCTS

EXPANSION JOINTS • HEAT EXCHANGERS • STEAM TRAPS • STRAINERS • SEPARATORS • METERS

AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS: NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.

Who's Building...

reportedly under consideration, including sections of New Jersey, Pennsylvania and Delaware. To cost an estimated $75 million, the new refinery is to replace the company's existing refinery at Bayonne, N. J.

Greek Representatives Seek Action on Refinery

Latest move by the Greek government to get construction started on a 30,000-barrel-a-day refinery in that country was the arrival last month in Washington of two Greek representatives. They are expected to spend several weeks in attempts to get action on the project.

Meanwhile, fresh bids have been published in Athens.

Talks have been held with various government officials, and a search begun for someone to build the refinery for the government account. It has been reported that German interests recently submitted a proposal to build the refinery. Earlier, Greece rejected refinery bids from Socony-Vacuum Oil Company, a group headed by Spyros Skouras and a joint bid of Anglo-Iranian Oil Company, Royal Dutch-Shell and Purfina.

It is believed that the Greeks would like to have somebody build and operate the refinery for at least two years. By then, apparently, it hopes that one of its marketers would be willing to operate the plant for the government.

Chillicothe Plans to Build Chemical Plant

Chillicothe Petrochemicals, Inc., recently reorganized, is planning construction of a $12 to 14 million plant at Chillicothe, Texas, to produce chemicals from natural gas. The plant will pro-

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

3-Methyl-1,6-hexandiol
alpha-Chloro-beta-naphthol
m-Aminodiphenyl
Tetrachlorohydroquinone diacetate
n-Dodecanesulfonic acid
Dithiohydroquinone
2,3-Dinitrotoluene
Triethyl phosphine
Tetramethylene sulfone
2-Methyl-8-aminoquinoline
Butadiene monoxide
5-Methylindole
2-Methyl-1-pentanol
1,4-Dihydronaphthalene
9,10-Diaminoanthracene
p,p'-Divinyldiphenyl
3-Vinylpyridine
5-Amino-1-pentene
Tetramethylethylene oxide
3-Nitrocarbazole

For Trouble-Free Pipe Threading ...its a 65R

RIDGID

This 65R threads 1" to 2" pipe with 1 set of dies ...and it won't jam!

You won't find a die stock to equal this popular 65R—anywhere! It saves time—one set of self-contained high-speed dies adjust to 1", 1¼", 1½" or 2" pipe or conduit in 10 seconds! Mistake-proof self-centering workholder sets to size instantly! It saves trouble—lead screw won't jam, it kicks out automatically when standard length thread is cut. Clean perfect threads, *fast!* For trouble-free extra-easy pipe threading buy 65R at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

RIDGID
Work-Saver Pipe Tools

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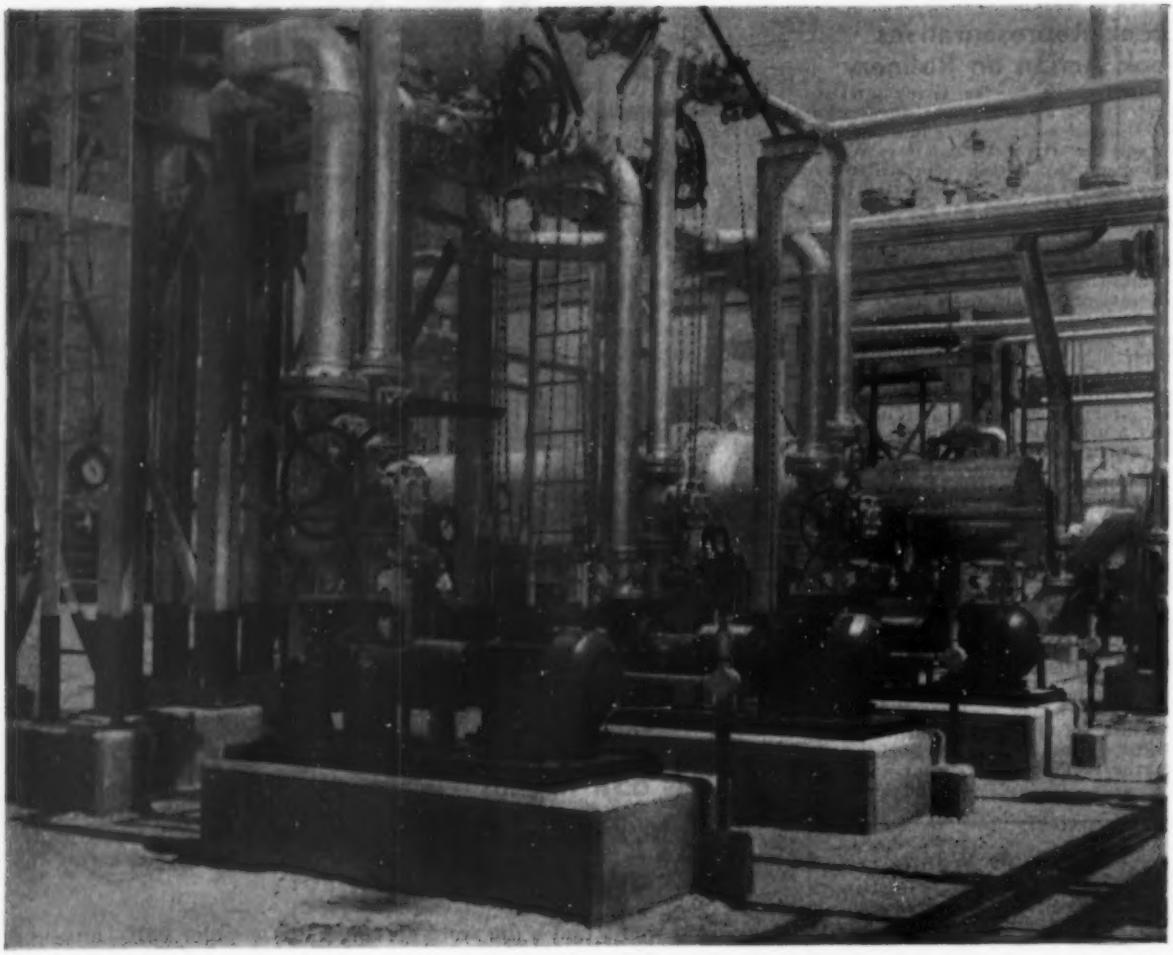
at 3-BAR GAS INJECTION & GASOLINE PLANT



Ingersoll-Rand SFLA Pumps meet a wide range of processing requirements at this Andrews, Texas plant operated by Stanolind Oil and Gas Company. The three 1½" **SFLA** units shown above are on debutanizer and depropanizer reflux service, handling 128 gpm of 90°, .55 sp. gr. reflux at 52 psig suction and 102 psig discharge. Other similar I-R pumps at this plant are used for still reflux, scrubber condensate and caustic mix services. The totally enclosed design of the rugged **SFLA** line, with integral mechanical shaft seal, assures maximum safety and dependability in refinery and process services.

Ingersoll-Rand, Cameron Pump Division, 11 Broadway, New York.

981-10

Who's Building...

duce 180 to 200 tons a day of ammonia and 150 tons of urea. Financing has not yet been completed.

Construction Capsules

Esso Standard Oil Company has put two new hydrofiners on stream at its Bayway refinery at Linden, N. J. The two facilities will produce 7640 barrels a day of heavy thermal naphtha and 19,520 barrels a day of cracked heating oil. Standard Oil Development Company licenses the Hydrofining process.

California Oil Company has placed a new 10,000-barrel-a-day UOP platforming unit on stream at its Perth Amboy, N. J., refinery. In building the new facility, contractors used as much equipment as possible from an existing UOP thermal reformer.

Sun Oil Company has concluded licensing arrangements with Houdry Process Corporation for an 18,000-barrel-a-day Houdriformer to be constructed at Sun's Marcus Hook, Pa., refinery.

Allied Chemical & Dye Company plans to begin production of adipic acid in October at its National Aniline division plant at Hopewell, Va.

Sid Richardson Refining Company has made no definite plans for reopening its 22,500-barrel-a-day refinery at Texas City, Texas, which has been closed down since June 30.

Eastern States Petroleum Company will build a 3000-barrel-a-day Unifining unit at its Houston refinery under license from Union Oil Company of California. Construction is scheduled to start immediately, with completion expected by September.

McBride Oil & Gas Corporation has put its Brownsville, Texas, refinery back on stream. The plant is operating at a capacity of 7500 barrels a day.

Mid-Continent Petroleum Corporation has started up a new 7500-barrel-a-day platformer at its West Tulsa, Okla., refinery. Designed and engineered by The M. W. Kellogg Company, the unit was built by Mid-Continent.

The Ohio Oil Company has begun construction of a natural gasoline plant in Nebraska, in Cheyenne County, to handle initially 12 Mmcf a day of gas.

Spencer Chemical Company plans expenditures of over $1.6 million to diversify its product line. Most of the increased facilities will be put in operation at Henderson, Nev., site of the company's ammonia facilities. Nitric acid is first in line for production.

Union Oil Company of California expects to start operation of a new 600-barrel-a-day catformer at its Cut Bank, Mont., refinery next month. Ralph M. Parson Company is building the unit, which is to cost an estimated $600,000. A 450-barrel-a-day Unifiner is also under construction at Cut Bank. Union also has started construction on its new Santa Maria, Calif., refinery. In addition to the coking plant, the company will build a sulfur plant having an estimated

When clean-outs eat profits

...TRY LAGONDA

The famous Lagonda 1100 Series refinery motor, with Type UO cutter head. A widely used combination.

INSIDE STUFF ON TUBE CLEANING

Here's a book prepared on the basis of over 50 years' experience. It has many valuable tips on tube cleaning procedure, and lists cutter heads and motors with data on their capabilities and usage. Covers other equipment too, such as catalyst cleaners, foot valves, hose, couplings, cleaners for large pipes and very small tubes. Write for illustrated Bulletin Y-34.

Clean-outs that move at a slow crawl, bite chunks out of profits. Decisive action is called for to step up the tempo. It's time to switch to the powerful Lagonda 1100 Series tube cleaner, armed with one of its hard-biting cutter heads, designed exactly for the type of coke that is slowing up your job. Your local Lagonda tube cleaning engineer will gladly supply complete cooperation, and probably chalk up one more to the long list of Lagonda "wins" against conditions that have defeated other means.

When clean-outs drag, 'phone your Lagonda man, or write Elliott Company, Springfield, Ohio. To get your stills back on stream *quick*, try Lagonda.

ELLIOTT Company

Y4-2

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

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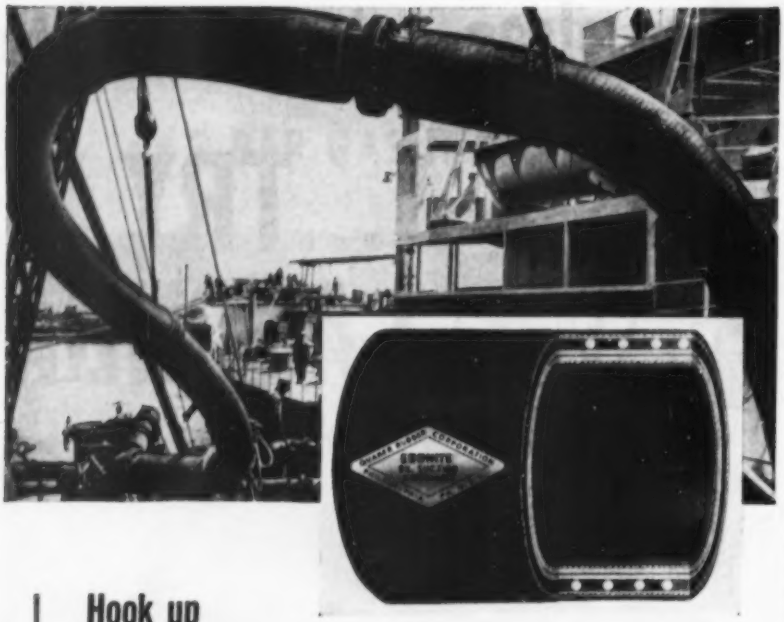

Hook up
with THIS for rugged service!

Quaker

EBONITE OIL SUCTION
AND DISCHARGE HOSE

For top capacity with minimum friction loss, here's the hose that *really* delivers—whether the flow is to or from the bunkers. Heavy grade tube is made of Ebonite oil-resistant compound. Single-ply breaker strip next to tube is frictioned for strong adhesion between tube and fabric reinforcement. High tensile spring steel wire surrounded by multiple plies prevents collapse under suction, expansion under pressure, and eliminates kinking and crushing. Reinforced ends safeguard against bending or breaking at nipple. For the hose that stands up to gruelling wear, use Ebonite—another Quaker quality product for smooth-flowing efficiency.

Write for free folder and name of nearest distributor

Belting, Hose, Packing and
Moulded Rubber of every
construction for every need.

QUAKER RUBBER CORPORATION
DIVISION OF H. K. PORTER COMPANY, INC.
OF PITTSBURGH
PHILADELPHIA 24, PA.
Branches in Principal Cities

Who's Building. . .

production of 42 tons of sulfur a day.

Shell Oil Company has put a new UOP platforming unit on stream at its Martinez, Calif., refinery. The unit has a design capacity of 5000 barrels a day and will process California naphtha to make high quality motor fuel blending component.

General Petroleum Corporation is approaching completion in work on its 35,000-barrel-a-day refinery at Ferndale, Wash. The installation is expected to be completed by this fall.

Husky Oil & Refining Company is presently winding up a modernization and expansion program at its Lloydminster, Alta., Canada, refinery to increase refining capacity to 10,000 barrels a day. The project includes a 2500-barrel-a-day addition to the crude distillation capacity, an 800-barrel-a-day expansion of the cycloversion catalytic reforming unit, and desulfurization facilities.

British American Oil Company, Ltd., has completed construction of refinery additions and a fluid catalytic cracking unit at its Clarkson, Ont., Canada, refinery. The project increased refining capacity to 11,600 barrels a day and cost an estimated $8 million.

International Petroleum Company has put a new 45,000-barrel-a-day pipe still and a 4000-barrel-a-day depropanizer on stream at its Talara, Peru, refinery. The new units, erected under contract by Arthur G. McKee & Company, will mostly replace old refinery installations originally built in 1916.

Refineria de Petroleos de Escombreras, S. A., plans a further expansion of its 30,000-barrel-a-day refinery at Cartagena, Spain, to 35,000 barrels a day. Also under study is a second stage of expansion which would cost about $6 million and boost the refinery's capacity to 60,000 barrels a day.

Tide Water Completes Avon Refinery Expansion

Another expansion of the refining facilities at Tide Water Associated Oil Company's Avon, Calif., refinery has been completed and the new facilities placed on stream.

The expansion program, undertaken to increase gasoline, diesel and heating oil production, provides additional feed preparation capacity, makes improvements to the thermal cracking facilities and adds a new boiler unit.

Imperial Breaks Ground For Edmonton Lube Plant

Ground has been broken and construction started on the new $14 million lubricating oil plant Imperial Oil, Ltd., is building at Edmonton, Alta., Canada.

The new lube plant will be the first in the west and second largest in Canada, topped only by Imperial's Sarnia plant. Construction is expected to be completed late in the summer of 1955. The plant will produce about 750,000 barrels of high quality automotive and

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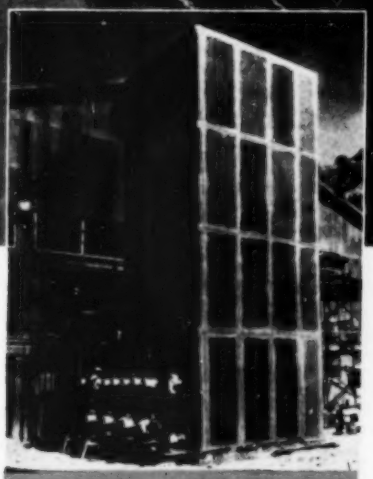
TONNAGE OXYGEN... continuous production at *lower cost*



Stacey Brothers' design pioneered the use of welded-aluminum construction for all low temperature parts . . . utilizes modern-design reversing exchangers for efficient "no-shut-down" operation . . . requires no chemicals . . . needs only minimum operating crew.

Turn first to Stacey Brothers when you need a tonnage oxygen plant with long-time low costs of operation and maintenance. Take full advantage of Stacey's specialized experience in design, engineering, fabrication, construction . . . all the way thru to final Acceptance Testing.

Write for Bulletin 0-50, **the complete story about Stacey Brothers oxygen plants. *Standard Designs are* ready for plants producing 10 to 50 tons per day.**

All-Aluminum low temperature parts remain ductile, increase in tensile strength at sub-zero temperatures, have high thermal conductivity . . . welded joints insure against leakage.

Reversing Exchanger Design permits economical continuous operation . . . no shut-downs for de-riming.

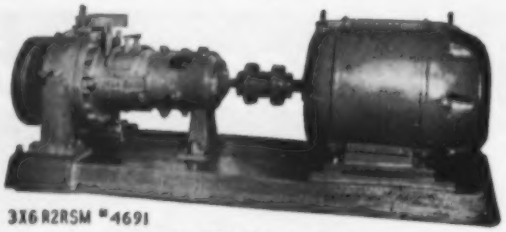
Stacey BROTHERS

STACEY BROTHERS DIVISION
Dresser-Stacey Company
5535 VINE STREET
CINCINNATI 16, OHIO

One of the Dresser Industries

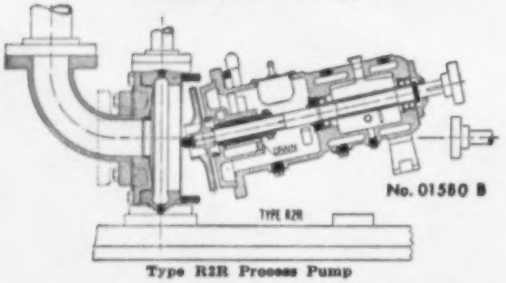
DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



3X6 R2RSM #4691

Type R2R Process Pump



Type R2R Process Pump

DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R2R. Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.
Capacities: 50 to 3000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL and RECIPROCATING PUMPS

4044H
Close Coupled Centrifugal Pump

3510
Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids

4043 AA
Pedestal Mounted Centrifugal Pump

3833
Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump

4728
Double Pedestal Bearing Centrifugal Pump

3556
Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST.

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

Who's Building . . .

industrial oil a year, or about 2000 barrels a day.

Du Pont Plans Increase in Teflon and Freon Output

E. I. du Pont de Nemours & Company, Inc., has scheduled an increase in the production of Teflon and its intermediate Freon-22.

Plans for Freon call for construction of a new plant on the site of Du Pont's Louisville Works. Construction of the new facilities will begin this summer under the direction of the company's Engineering department. Completion is set for early fall, 1954. Capacity of the plant was not disclosed.

Plans for Teflon call for a doubling of the present capacity of the company's Washington Works near Parkersburg W. Va. Erection of the new facilities will be started this summer as an addition to the works. Construction will be completed next summer.

Gulf Starts Construction Of Gas Treating Plant

The Girdler Company, Louisville, Ky., is scheduled to start construction of a Girbotol gas purification plant at Gulf Oil Corporation's Port Arthur, Texas, refinery this month. The plant will employ a diethanolamine solution to remove carbon dioxide and hydrogen sulfide from a gas stream used as a charge stock for an ethylene plant.

The new facility is expected to be placed in operation in December.

Atlantic Now Operating Synthetic Ammonia Unit

The first synthetic ammonia plant in the Middle Atlantic Coast area has begun operations at the Philadelphia refinery of The Atlantic Refining Company.

The new $5.5 million unit has a daily rated capacity of 100 tons of anhydrous ammonia. About 60 percent of this thruput is slated for use in industrial chemicals, the rest going for farm needs.

Woodlawn Processing Puts Gasoline Plant On Stream

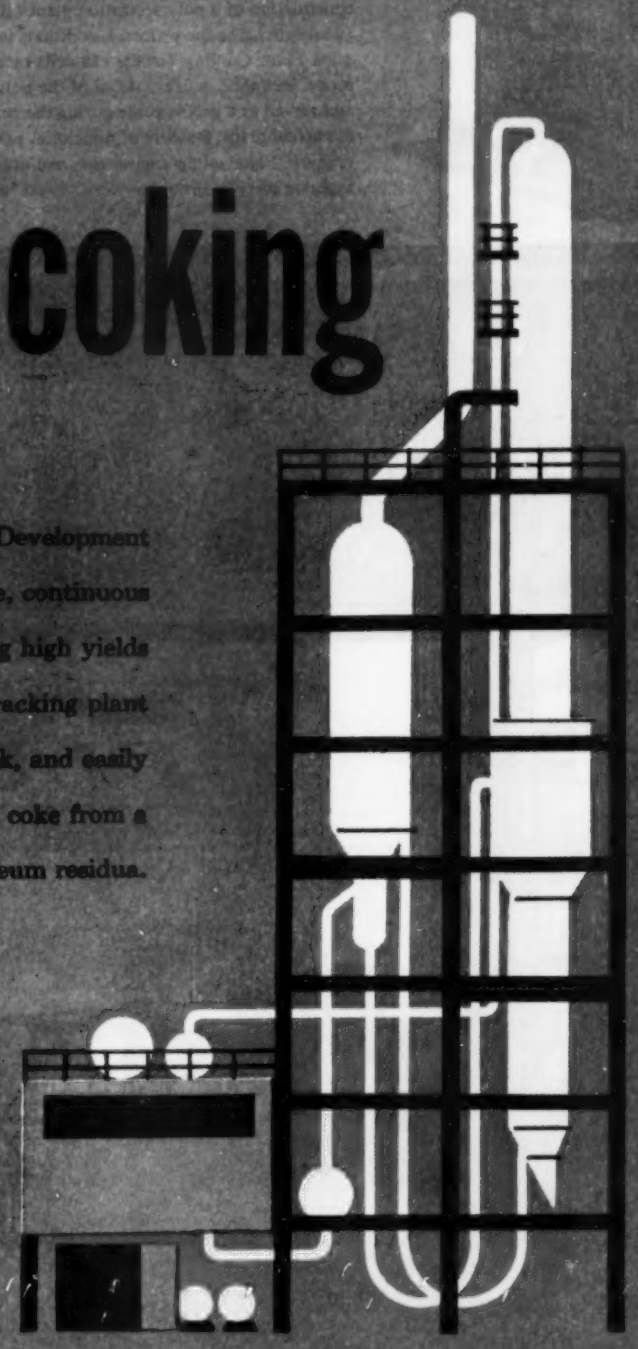
A new natural gasoline plant has been placed in operation in Woodlawn field, Harrison County, East Texas. The Woodlawn Processing Corporation installation cost an estimated $1,635,000 and has a gas processing capacity of about 45 Mmcf of gas a day. The present rate is about 14.5 Mmcf a day.

Catalyst Facilities Expanded

Construction has started on a major addition to Girdler Company's catalyst facilities at Louisville, Ky. The addition, being built adjacent to Girdler's activated carbon plant, is scheduled for completion late this year or early the next. The company plans to consolidate its catalyst operations at the new unit.

fluid coking

Standard Oil Development Company's flexible, continuous process for producing high yields of catalytic cracking plant charge stock, and easily handled, fluidized coke from a variety of petroleum residua.



Blaw-Knox is licensed to offer the fluid coking process under patents of the Standard Oil Development Company

BLAW-KNOX COMPANY chemical plants division

Tulsa 1, Oklahoma / Pittsburgh 22, Pennsylvania / Chicago 1, Illinois

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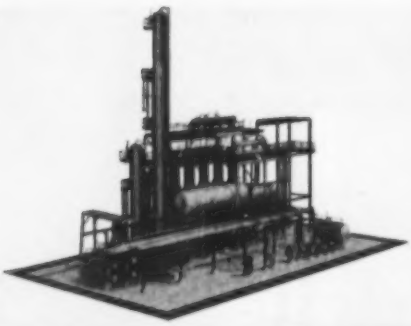

WATSON, CALIFORNIA. Fluor's part in the $40 million expansion program at Richfield Oil Corporation's refinery here, consisted of the engineering and construction of a polymerization plant (shown below), a super fractionation system (while changing the process), additions to the alkylation units, the erection of two giant Fluor Cooling Towers (18 cells each), and offsite facilities. A scale model complete in every detail of the poly plant was first built in Fluor's model shop and served as a useful guide during the engineering and construction stages of the actual plant. Because of difficulties presented by limited ground space at the refinery, Fluor set up engineering and drafting personnel right at the jobsite to expedite the job. Problems were solved "on location" to conserve time.

THIS PLANT DESIGNED
AND CONSTRUCTED BY
THE FLUOR CORPORATION LTD.
LOS ANGELES

BE SURE WITH

FLUOR

THE FLUOR CORPORATION, LTD
LOS ANGELES 22, CALIFORNIA

FLUOR OF CANADA - TORONTO
FLUOR PERUANA, S.A. - LIMA
REED BRIGHTSON - LONDON

ENGINEERS
CONSTRUCTORS
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NEW YORK
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BOSTON
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HOUSTON
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TULSA

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Who's Meeting . . .

Fall is the time of year when meetings for refiners get into full swing. There are meetings for practically every speciality group within the industry. Refiners whose interests lie in chemical development, corrosion, testing methods, and power will find the following meetings of particular interest.

. . . **The National Chemical Exhibition** will open its doors on an extensive array of exhibits at Chicago on October 12-15. In addition several chemical societies will sponsor symposiums on packaging, transportation, and exposition marketing of chemicals.

. . . **The National Exhibition of Power and Mechanical Engineering** will display its exhibits at Philadelphia on December 2 to 7. This show is the twenty-first in the series which was last held in New York two years ago.

. . . **The National Association of Corrosion Engineers,** which sponsors regional meetings throughout the year, has scheduled its South Central regional meeting for Dallas on October 14 thru 15. Symposia will be presented on cathodic protection, protective coatings, inhibitors, processing plant corrosion problems, pipe line corrosion and oil and gas production.

. . . **A Symposium on Methods for Testing Liquefied Petroleum Gas** will be held September 27 thru 28 in St. Louis. The symposium is jointly sponsored by ASTM Committee D-2 on petroleum products, ASTM Committee D-3 on gaseous fuels, The Natural Gasoline Association of America and California Natural Gasoline Association. It's the first of its kind dealing strictly with testing liquefied petroleum gases. This meeting, in addition to full days of technical papers, will have an interesting display of specialized LPG testing equipment.

. . . **Another newcomer** in the fall meetings will be the "Electrical Conference of the Petroleum Industry" scheduled for September 27 through 29 in Tulsa, Okla. This three-day technical conference is being held under the sponsorship of the Petroleum Industry Committee of the American Institute of Electrical Engineers with the Tulsa section of the Institute acting as host. The purpose is to enhance further the art of electrical engineering and provide interchange of electrical technology through an industry wide coverage of applications in oil and gas production, refining, transportation and allied petrochemical fields.

The keynote address will be delivered at the opening session by Major A. N. Horn of Texas Empire Pipe Line Company, Tulsa. Major Horn is expected to review the work done in the organization of this committee and outline the purposes and aims to be accomplished for the betterment of electrical engineers associated in the petroleum industry and possible movement towards standardization of equipment. The following papers are of particular interest to refiners:

"Training of Maintenance Personnel at Socony-Vacuum Refinery"

"Some Features of Power Systems for Oil Refiners."

"Problems of Power Suppliers in Relation to Sales to Oil Industry Applications, Competition, and Facility Agreements"

"Lightning Protection in Petroleum Refineries and Chemical Plants"

"The Background, Intent, and Application of the Rules Contained in Article 500 of the National Electrical Code"

"Application of Large AC Motors and Control to Refineries and Pipelines"

"Uses of Radioactive Substances in the Petroleum Industry"

"Use of Electric Heating in Relation to Paraffin Problems"

"Electric Equipment Maintenance Costs, Motor Control for Indoor and Outdoor Applications"

. . . **The First International Instrument Congress and Exposition** opens in Philadelphia on September 13. In addition to a very elaborate technical program and exhibits, there will be a pre-conference clinic on maintenance which will offer to instrument men and apprentices instruction on maintenance of various basic types of instruments.

FUTURE MEETINGS, Page 188

Humble Makes Additions To Baytown Refinery Staff

Humble Oil & Refining Company has announced the following staff additions at its Baytown, Texas, refinery:

Kenneth Lee Nall, M.S. degree in mechanical engineering, Alabama Polytechnic Institute, to Maintenance department of the Engineering division; Richard T. Moravek, Ph.D. in chemistry, Louisiana State University, to Research and Development division; and David F. Griffith, B.S. in chemical engineering, Rice Institute; Don R. Moore, B.S. in chemical engineering, University of Texas; Donald A. Foster, B.S. in chemical engineering, University of Oklahoma; and W. Kenneth Brinkley and Hollie L. Briscoe, B.S. in chemical engineering, Texas A. & M. College, to the Technical Service division.

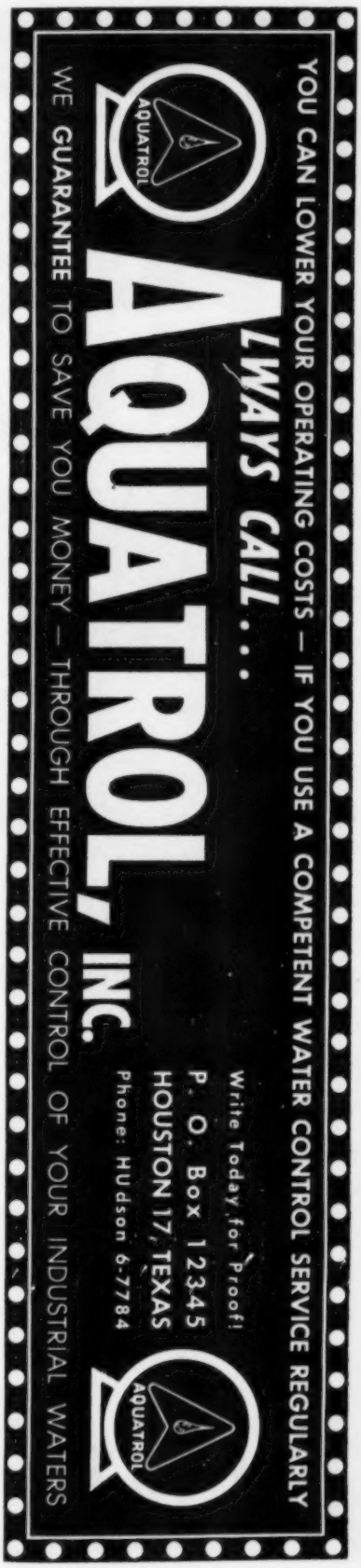
J. J. Samuels, B.S. in chemical engineering, University of Alabama, recently returned to the Technical Service division after serving two years in the U. S. Army.

Oden Opens Consulting Office at Lake Charles

E. Clarence Oden, formerly chief process engineer of Cities Service Refining Corporation at Lake Charles, La., has set up a consulting office in Lake Charles. He is a licensed professional engineer in Louisiana.

California Standard Will Hold Fourth Faculty Meet

Fifteen educators representing as many colleges and universities in the Far West and Hawaii are to participate in Standard Oil Company of California's Fourth Annual Faculty Seminar beginning August 29.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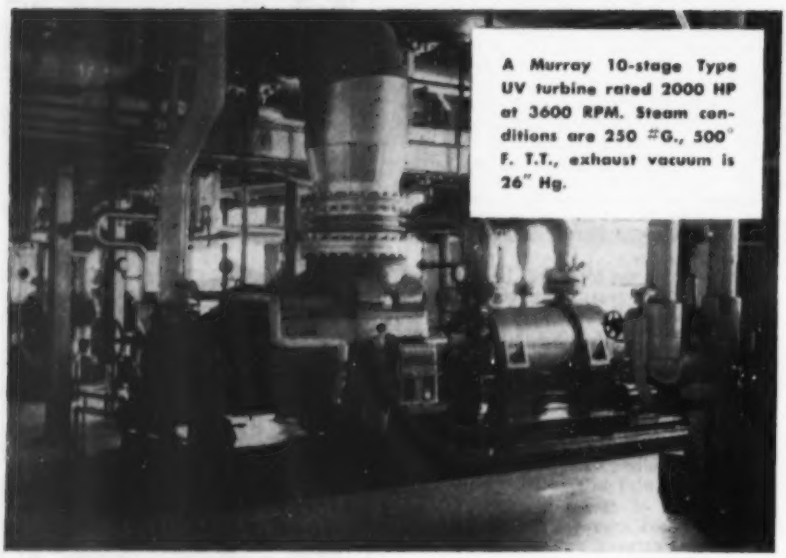
Murray Turbines



A Murray 10-stage Type UV turbine rated 2000 HP at 3600 RPM. Steam conditions are 250 #G., 500° F. T.T., exhaust vacuum is 26" Hg.

● The Murray Type UV turbine pictured above has been driving a high pressure lean oil pump in a Southwestern refinery for the past 10 years. And is still giving dependable, trouble-free service.

Murray mechanical drive turbines both single and multi-stage can be furnished in a wide range of ratings for steam pressures ranging from 0 to 600 #G., condensing and non-condensing. Types in the higher pressures available for up to 250 #G. back pressure.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

CALENDAR OF MEETINGS

AUG.	
16–18	Society of Automotive Engineers (National West Coast Meeting), Statler Hotel, Los Angeles.
20	Southern Gas Association (Natural Gas Processing Conference), Herring Hotel, Amarillo, Texas
23–25	Appalachian Gas Measurement Short Course (14th Annual Session), West Virginia University, Morgantown, W. Va.
SEPT.	
8–10	Oil Industry Information Committee, Conrad Hilton Hotel, Chicago.
8–10	American Society of Mechanical Engineers (Fall Meeting), Schroeder Hotel, Milwaukee, Wis.
12–16	American Institute of Chemical Engineers, Hotel Colorado, Glenwood Springs, Colo.
12–17	American Chemical Society, New York.
13–24	First International Instrument Congress and Exposition, Commercial Museum and Convention Hall, Philadelphia.
15–17	National Petroleum Association (52nd Annual Meeting), Traymore Hotel, Atlantic City, N.J.
15–17	American Petroleum Institute Lubrication Committee, Traymore Hotel, Atlantic City, N.J.
17	Natural Gasoline Association of America (Regional Meeting), Skirvin Hotel, Oklahoma City, Okla.
23–24	Western Petroleum Refiners Association (Regional Meeting), Henning Hotel, Casper, Wyo.
27–28	Symposium on Methods for Testing Liquefied Petroleum Gases, Statler Hotel, St. Louis, Mo.
27–29	American Institute of Electrical Engineers (Joint Meeting with Tulsa Engineers Club), Mayo Hotel, Tulsa.
27–30	American Society of Mechanical Engineers (Petroleum Division), Statler Hotel, Los Angeles.
OCT.	
3– 7	ASTM Committee D-2 on Petroleum Products and Lubricants, Sheraton Park Hotel, Washington, D.C.
7–8	California Natural Gasoline Association (29th Annual Fall Meeting), Ambassador Hotel, Los Angeles.
12–15	Eighth National Chemical Exposition, Chicago Coliseum, Chicago.
14–15	National Association of Corrosion Engineers (South Central Regional Meeting), Dallas, Texas.
17–20	American Institute of Mining and Metallurgical Engineers (Fall Meeting, Petroleum Division), Plaza Hotel, San Antonio, Texas
18–22	National Safety Council, Chicago.
21–22	Western Petroleum Refiners Association (Regional Meeting), Garrett Hotel, El Dorado, Ark.
25–27	National Lubricating Grease Institute (Annual Meeting), Mark Hopkins Hotel, San Francisco, Calif.
25–29	American Institute of Electrical Engineers (Fall General Meeting), Chicago.
29	Natural Gasoline Association of America (Southern Regional Meeting), Blackstone Hotel, Tyler, Texas.
NOV.	
4– 5	Society of Automotive Engineers (National Fuels and Lubricants Meeting), Mayo Hotel, Tulsa, Okla.
8–11	American Petroleum Institute (34th Annual Meeting), Conrad Hilton Hotel and Palmer House, Chicago.
5–17	American Standards Association (Annual Meeting), Roosevelt Hotel, New York.
28 to Dec. 3	American Society of Mechanical Engineers, Statler Hotel, New York.
Dec.	
2– 7	National Exposition of Power and Mechanical Engineering, Commercial Museum, Philadelphia.
3	Natural Gasoline Association of America (Panhandle-Plains Regional Meeting), Herring Hotel, Amarillo, Texas.
8–10	Oil Industry Information Committee, Waldorf-Astoria, New York.
12–15	American Institute of Chemical Engineers (Annual Meeting), Statler Hotel, New York.

CHEMICAL PROCESS NEWS

PUBLISHED BY CHEMICAL PROCESS DIVISION, THE M. W. KELLOGG COMPANY AUGUST 1954

NOTES ON SYNTHOL

Synthol is the name of the Kellogg-developed process for catalytically reacting synthesis gas (carbon monoxide and hydrogen) to produce a wide variety of hydrocarbon materials and chemicals. Synthesis gas for the process can be derived from either natural gas or coal.

* * *

The first plant to utilize Synthol on a commercial scale is now under construction by Kellogg in South Africa. Partial combustion of coal (from vast deposits near the plant site) will form the source of the synthesis gas; primary products of the plant will be "petroleum" fuels—around 60 million gallons per year, of which the major part will be motor gasoline.

* * *

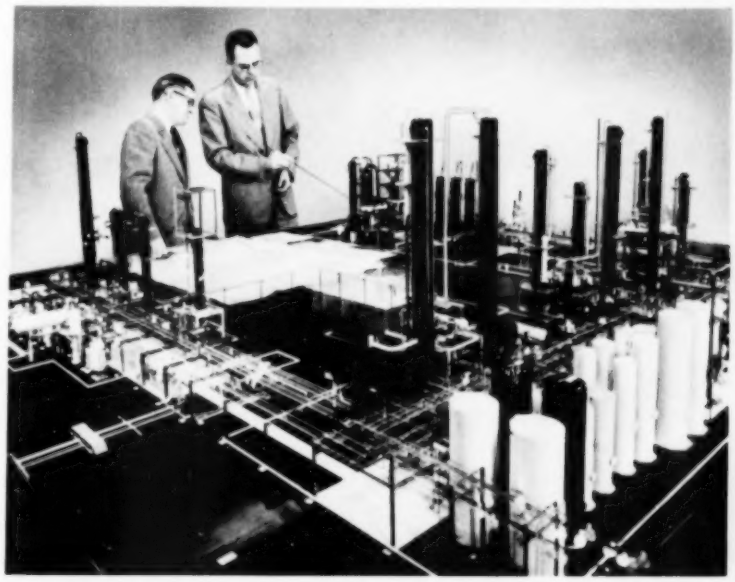
In addition to gasoline and fuel oil, the plant's output will include an impressive quantity of industrial and agricultural chemicals—about 125 million pounds. Many of these are oxygenated compounds, produced as by-products in the Synthol unit. While their volume is small in comparison with the enormous amounts of fuels produced, the higher market value of these chemicals adds substantially to the over-all attractiveness of the Synthol process.

* * *

The water-soluble or chemical stream from the Synthol unit is passed through a series of operations involving both extractive and conventional distillation to separate methanol, anhydrous ethanol, methyl ethyl ketone, and acetone. The methanol will be used as a solvent in the process and the ethanol will be blended into the gasoline pool. The other two chemicals will be marketed.

* * *

Additional equipment is being installed to produce commercial grade propanol and/or butanol, or to further process these products as additional gasoline.



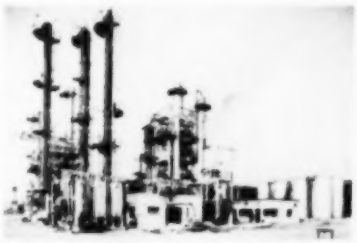
Low Production Costs, High Yields and Flexible Operation Characterize New Phenol-from-Cumene Process

Shown above is a detailed model of a unique chemical plant Kellogg is currently building for Hercules Powder Company at Gibbstown, N. J. The plant will produce phenol, acetone, and methyl styrene, using the Hercules-Distillers process for oxidizing and splitting cumene. Kellogg, which developed the mechanical design of the commercial process in collaboration with Hercules, is also the originator of the process to be used for making the cumene feed.

The over-all process offers an unusual example of how refinery products can be upgraded to industrial chemicals to obtain a radical increase in value. Propylene, for example, which makes up one-third the volume of the initial feedstock, is readily available at low-cost. It can be combined with benzene by alkylation to form cumene, which is then oxidized to cumene hydroperoxide. The latter is subsequently split in a cleavage reaction to form the final products.

Of these, the phenol portion of the output is derived from the benzene part of the initial input. In the same way, the acetone produced is attributable to the low-cost propylene third of the feed.

As compared with other processes, the latter product—acetone—at present prices provides a bonus for the phenol produced as a major product. Moreover, the comparatively small quantity of methyl styrene produced can be separated and sold for use in the plastics industry, or it can be easily converted back to cumene and re-used in the process.



Recently completed phenol-from-cumene plant in Canada.

(continued on following page)

CONTINUED FROM PRECEDING PAGE

Kellogg to Build Second Ethylene Plant for British Producer

Engineering is now virtually complete and construction is scheduled to begin shortly on the second ethylene plant to be designed and built by Kellogg for an important producer of chemicals in the British Isles. With a similar plant which is now under construction in Italy, the new one brings to a total of three the number of plants utilizing Kellogg's unique process for the steam-cracking of petroleum fractions to make olefins.

As embodied in these plants, Kellogg's process is characterized by high yields of high purity ethylene, and by high conversion of the feed without coking of furnace tubes. The prototype plant has now been in operation in England for more than two years and at no time has a shutdown been caused by furnace coking.

In essence, the process consists of a special high-temperature pyrolysis section in which naphtha or gas oil vapors are broken down, in the presence of steam, into ethylene and other gaseous fractions. These are then separated in a special low temperature fractionation system developed by Kellogg which allows production of ethylene of the extremely high purity needed for polyethylene manufacture. The process has demonstrated a high flexibility in both the handling of various feedstocks and in the ratios of desired products (olefins and aromatics) in the output.

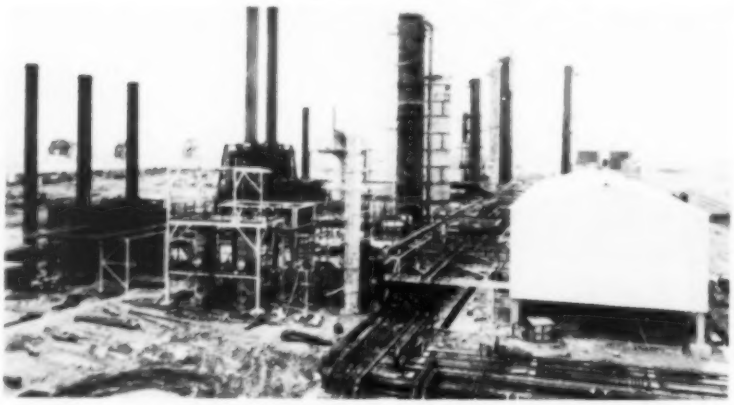
The new plant, while not a duplicate of its predecessor, will preserve the general over-all features of the first plant but will include some additional process improvements. It will be slightly larger, and, like the first plant, will crack heavy naphtha for the primary production of ethylene to be used for manufacturing polyethylene.

(continued from previous page)

Low Production Costs..

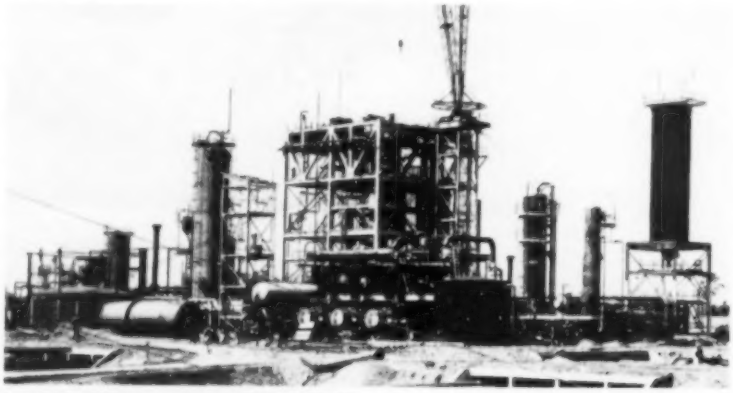
In addition to these valuable economic considerations, the process requires comparatively low initial investment and operating expense. High pressures or temperatures are not used and consumption of chemicals such as alkalis and acids is comparatively low.

Work Progresses on Sasol Plant



Shown here are two major sections of the multi-million-dollar synthesis project now under construction by Kellogg in South Africa. While the primary purpose of the plant is to synthesize gasoline and other oil products from coal, it will also produce large volumes of valuable chemicals which will be purified in Kellogg-designed equipment. (Photo above shows fractionation equipment for both oil products and chemicals.)

Shown (below) well underway is the most important unit in the process sequence. This is the Kellogg Synthol unit which will catalytically convert synthesis gas to liquid hydrocarbon and chemical products. (See preceding page for further details on Kellogg's Synthol Process.)



For further information, technical data, etc., relating to chemical or petrochemical processing, write

CHEMICAL PROCESS DIVISION

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- ★ Polyethylene
- ★ Phenol-from-Cumene
- ★ Anhydrous Ammonia
- ★ Methanol
- ★ Phthalic Anhydride
- ★ Liquid Fuel and Chemicals Synthesis from Coal
- ★ Glyceride Purification
- ★ Nitric Acid
- ★ Ammonium Nitrate
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As Management Sees It . . .

Bald-head basking is bad . . .

Avoid Sunstroke and Heat Exhaustion

B. B. Reeve, M.D., Medical Director,
Standard Oil Company (Indiana)
Chicago

ONCE WINTER passes we quickly forget the ice and snow, the icy blasts, and all the prevalent ills that go along with the season.

This is fine—but we forget last summer's heat just as quickly.

For our health's sake, we must protect our bodies from excessive heat and its dangers.

Hot weather brings with it two physical dangers—heat exhaustion and sunstroke (heatstroke). Many think of these conditions as one and the same. It is important to know that this is not true.

The cause is the same—excessive exposure to the hot sun or too intense heat, indoors or out.

The symptoms and reactions are different. Heat exhaustion and sun stroke call for different forms of treatment.

This may means the difference between life and death. It is important to know the symptoms of each, what to do in first aid treatment, and how to prevent them.

Heat Exhaustion—Symptoms—Heat exhaustion is a condition brought on by exposure to abnormal heat while the body is subject to exertion. It is characterized by paralysis of the nerve center that controls the circulation, followed by prostration and low body temperature.

The symptoms will vary according to the severity. In mild cases there is a feeling of marked weakness after exertion, with yawning and sighing. If the condition progresses, intense prostration develops—with nausea, unquenchable thirst, and dizziness. The person is pale. The skin is cold and clammy, yet there is copious perspiration. The temperature is sub-normal. The pulse is weak. Many develop severe body cramps. Most cases remain conscious but some may faint or drop off into a sleep. Heart failure may occur in weak or elderly cases, but most will recover in a few hours to a few days, if properly treated.

The body cramps are apparently due to an unbalanced chemistry of the body as a result of loss of body salts through excessive perspiration. This requires quick medical aid for relief.

Heat Exhaustion—Treatment—In heat exhaustion, call a doctor immediately.

In the meantime, remove the patient to a well-ventilated, comfortable place.

See that his clothes are loosened.

Cover patient with blankets. Apply heat in the form of hot water bottles, or whatever form of heat is available, in order to bring the body heat back to normal. Be careful not to apply hot water bottles directly to the skin, to avoid severe body burns.

If the patient is conscious, hot drinks are valuable.

As a preventive measure against heat cramps, many industrial concerns furnish salt tablets or add salt to the drinking water to replace salts lost by excessive perspiration.

Sunstroke (Heatstroke)—In this condition the preliminary symptoms are similar to those of heat exhaustion, such as dizziness, nausea, and acute headaches.

Beyond them, in sunstroke the signs and symptoms change. The skin becomes dry and hot. The face is red or flushed. The temples throb. patient is short of breath and it is difficult for him to breathe. The pulse is forceful and rapid. The heart is pounding. The temperature is high. This can be detected just by applying the hand to the patient's skin.

If the condition progresses, the patient becomes unconscious and may be in convulsions. Temperatures above 110 degrees have been recorded—death may occur unless immediate treatment is started.

Sunstroke—Treatment—In sunstroke, also call a doctor immediately. In the meantime, start first aid at once.

Lay the patient on his back in a cool place.

Remove as much clothing as possible.

Reduce the temperature by sponging the body with cold water. The quicker the temperature is reduced, the better the chances are of complete recovery. A prolonged high temperature may leave permanent damage even though the patient survives.

Under a physician's direction, ice packs may be used to reduce the temperature rapidly, but the patient must be watched closely as the temperature subsides to prevent the temperature from becoming sub-normal. Warm blankets should be made ready. Place the patient in them after the temperature reduction.

Lingering After-Effects—Both heat exhaustion and sunstroke are a shock to the body.

After recovery, some cases develop undue sensitiveness to high temperatures, and when exposed later to heat, may develop symptoms such as acceleration of pulse and respiration, digestive disorders, headaches, and dizziness.

Some people also develop irritability of disposition with onset of warm weather. For such persons, continuing medical treatment is advised.

That Ounce of Prevention—Individuals can become acclimated to higher temperatures, or develop some tolerance, if properly seasoned to heat. Therefore, it is important for people who are not accustomed to heat to watch themselves closely and gradually condition themselves to higher temperatures.

Some appear to be more sensitive to heat than others. Such persons should be aware of their intolerance

STOP CORROSION
with BIRD-ARCHER AMINE TREATMENT

Unretouched photograph shows the ravages of corrosion on condensate return lines.

Corrosion of piping in steam and condensate return lines is an expensive two-way headache. (1) It leads to large outlays for pipe replacement and maintenance. (2) It often results in plugged return lines and traps due to the solid products of corrosion. Bird-Archer Amine Treatment effectively eliminates these troubles at low cost.

Here's how. Amines are fed into the boiler or into the steam and condensate systems. The amines raise the pH value of the condensate and also tend to inhibit equipment-destroying corrosion through surface protection of the metal itself. In scores of plants, this Bird-Archer system has more than paid for itself by substantially cutting replacement and maintenance costs.

BA-PC2

Bulletin CP 100
gives all the facts on Bird-Archer Amine Treatment. Write for your copy.

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As Management Sees It . . .

of heat and avoid exposure beyond their personal limits.

Individuals with certain physical defects, such as heart disease and other organic diseases, are likely to be still more seriously affected if exposed to undue heat conditions.

The important thing here, as so often in other matters of health, is prevention:

- Avoid unnecessary prolonged exposure to direct sun rays and excessive heat, either indoors or out.
- Be sure you are conditioned to the task ahead.
- If you expect to be out in the direct sun rays for any length of time, wear proper protective head gear. Prevent the sun rays from striking the face and the top of the head, especially if bald. Bald-head basking is bad.
- Heed warnings. Heat cases have warning symptoms but fail to recognize or heed them. If you begin to feel ill while exposed to the heat, take immediate measures to get to a cool protected place. Do not return to further exposure until you are sure you are all right.

Health Measures for Hot Weather—People who live in the tropics have learned to protect themselves from the ill effects of direct sun rays. Those who live in cooler climates often seem to forget that the sun and heat can be most dangerous.

When summer arrives, it is better to be an ounce wise and not a pound foolish—when it comes to heat exposure.

Here's how:

Be sensible, protect yourself, and wear proper clothing.

Maintain a well-balanced diet, avoid over-eating.

Add extra salt to your food when hot weather causes excessive perspiration—unless for you salt is contra-indicated.

Wear light, loose, comfortable clothes.

Don't over-expose your skin to direct sun rays.

If sick or in poor health, avoid excessive heat exposure.

Wear head protection if out in the sun for any prolonged time.

Get the proper amount of rest. Air conditioning, more common where extreme heat is a factor, permits more comfortable sleeping and permits the body system to become refreshed before starting out the next day.

In summer's heat, as in winter's cold, good habits mean better health.

Be wise—heat-wise.

Tough...

to resist high pressures
...blistering heat

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Republic-made alloy steels provide the toughness and strength needed to resist the most severe pressure, heat and corrosive conditions.

These long-lasting studs can be tightened without danger of stripping or slipping. Clean, accurate threads provide maximum holding power, resistance to wear and trouble-free back-off for maintenance.

Carry Republic Alloy Steel Studs in stock for replacements on present equipment. Specify them on new equipment orders.

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AS Management Sees It . . .

Where's the Fire?

Fire extinguishment in oil processing, storage and transport facilities.

Part VI

H. B. Williams, Director, Safety and Fire Protection,
Pan American Refining Corporation,
Texas City, Texas

Lifter Roof Tanks
(Refrigerated Products)
All Fires Resulting from Uncontrollable Large Loss of Flammable Vapors

1. *Caution:* Do not extinguish flames except by fuel elimination as described in the following paragraphs.

2. If fire is impinging upon the tank, apply cooling streams to the affected parts. Avoid heavy direct streams which might damage the sheet metal cover and insulation. Apply cooling streams to other affected tanks.

3. Keep the water seal of the tank filled to overflowing to guard against vapor release. This may require directing heavy streams of water onto the roof.

4. Stop all transfer of product into the tank. The liquid stream from the refrigeration compressors should be routed to unaffected storage in order to reduce the vapor pressure of the material within the burning tank. Maintain a rate of refrigeration sufficient to control the roof.

5. If the roof cannot be controlled by the refrigeration compressors, relieve excess internal pressure by operation of the emergency compressors discharging to the plant torch. If an excess of internal pressure still exists, vent to the emergency torch west of the main pump house after placing an igniting torch at this outlet.

6. Open firewall drain valves as required to remove water from the tank basin at a rate that will maintain a water seal over the sewer opening. This is to prevent propagation of flame through the sewer lines.

7. Pump out product to unaffected storage if possible to reach and operate control valves.

8. Balance the liquid withdrawal (to maintain positive pressure within the tank) by cutting out compressors and if necessary, introduce steam to the tank heater.

9. When product pumpout has reached the limit as determined by available storage, pump operation, etc., remove the tank from service according to usual operational plans. As the *vapor pressure* of the material within the tank is reduced (as indicated by the characteristics of the flames) it may be necessary to introduce fuel gas in order to maintain positive pressure within the tank and thus avoid drawing flame into the tank.

10. Permit a complete burn out of remaining flammable materials at the point of leakage. Extinguish the flame by shutting off the fuel gas supply.

Lifter Roof Tanks
(Refrigerated Products)
Manifold Fires

1. Apply water spray or high pressure water fog to blanket affected lines and valves and to protect the tank shell insulation.

2. Carefully analyze the situation, giving consideration to the following factors to determine if quick repair of the leak can be made if the flames are extinguished.
   (a) The height of the flame which indicates volume of escaping vapor.
   (b) The torch effect of the flames caused by pressure.

3. If extinguishment and repair are decided upon
   (a) Operate the compressors to lower the roof to its bottom position. From this point, regulate compressor operation to maintain the least positive internal pressure. Avoid pulling a vacuum on the tank.
   (b) Discontinue application of cooling water and simultaneously discharge dry powder to extinguish the flames.

4. Should it be determined that repairs cannot be successfully completed
   (a) Prepare lines for removing the tank from service.
   (b) Evacuate the area and ignite the escaping vapor to prevent drift and flash-back from other refinery facilities.
   (c) Proceed with the *Master Plan* of lifter roof tank fire extinguishment outlining procedures for fires resulting from uncontrollable large loss of flammable vapors.

Lifter Roof Tanks—Low Flash Oils
All Fires

1. Apply snuffing steam to the tank vent steam ring.

2. Keep the water seal of the tank filled to overflowing.

3. If fire is impinging upon the tank, apply cooling streams to the affected parts. Avoid heavy direct streams which might damage the sheet metal cover and insulation.

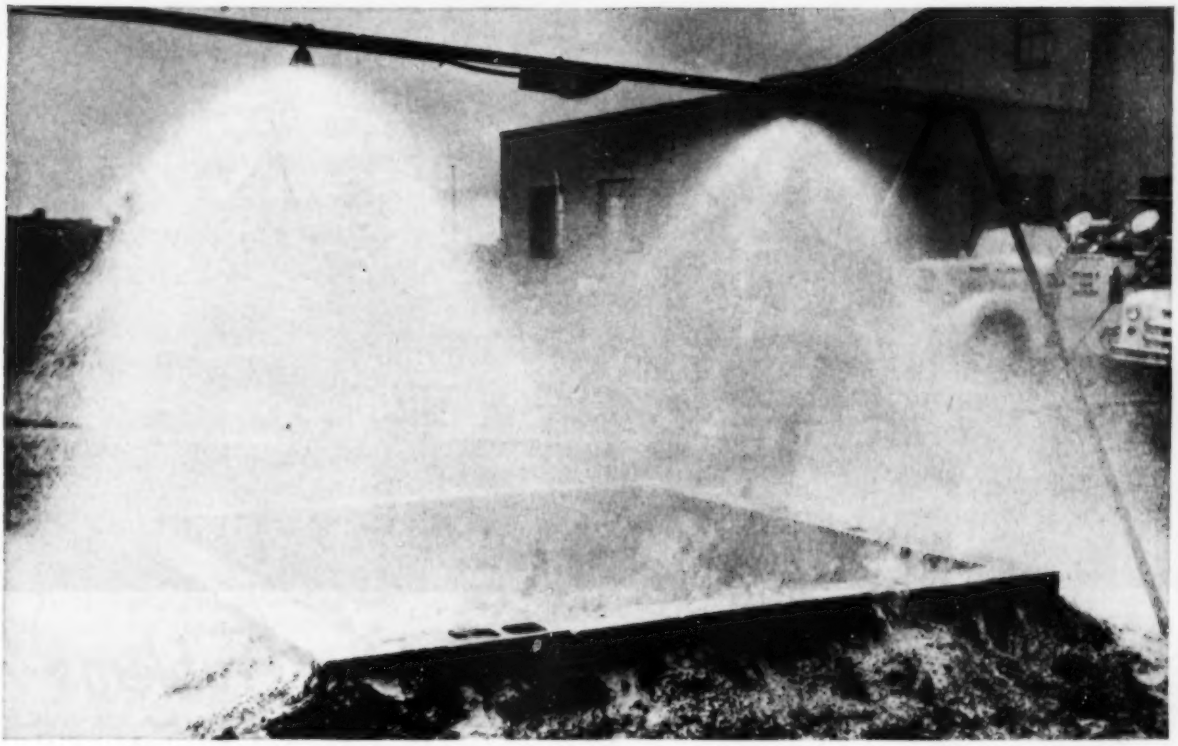
4. Extinguish fires in the firewall basin with foam to reduce heat input to tank contents.

5. Apply chemical foam through all fixed foam connections by means of portable foam generators.

6. In case of destruction of one or more fixed foam connections by roof failure, foam should be applied through a corresponding number of portable towers discharging over the tank rim.

7. Open firewall drain valves to full capacity to avoid flooding of the firewall basin.

8. Apply cooling water to other tanks exposed to heat of fire.



Demonstration shows Rockwood FogFOAM SPOT Protection extinguishing gasoline fire.

How to quench a sudden flareup

Don't give danger "spots" a chance to wreck you! Give them the kind of coverage shown in the demonstration above. Here, a gasoline-filled pit was set on fire — and extinguished in a matter of seconds by a Rockwood *Spot Protection System* discharging Rockwood FogFOAM. This FogFOAM also provided fire protection to the surrounding area by covering the edges of the pit.

Rockwood FogFOAM is formed by mixing 3 parts Rockwood Double Strength FOAM with 97 parts water — then discharging it through specially engineered FogFOAM heads or nozzles. A protein type liquid, it is used in spot protection systems and also in fire hose lines by being discharged through the Rockwood Type SG-60 Nozzle or Type FFF Nozzle. The Type SG-60 Nozzle discharges high velocity FogFOAM, solid FOAM stream (through an Extension FOAM Shaper) and, when FOAM is shut off, high velocity WaterFOG, low velocity WaterFOG or straight water stream. For ¾", 1" and 1½" fire hose lines.

Put these firefighters to work for you.

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

Rockwood Double Strength Foam clings to metal surfaces as an insulator, flows freely at sub-zero temperatures. Excellent for extinguishing fires in gasoline, benzol and other highly volatile flammable liquids as well as ordinary combustibles.

Rockwood Wet makes water go farther. One part of Wet mixed with 99 parts water, increases penetration and extinguishing action of water. A "must" for deep seated fires and where water is scarce. Helps reduce amount of time and manpower.

SEND FOR THIS INFORMATIVE BOOKLET

ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
388 Harlow Street
Worcester 5, Mass.

Please send me your illustrated booklet on Rockwood fire-fighting products.

Name .....

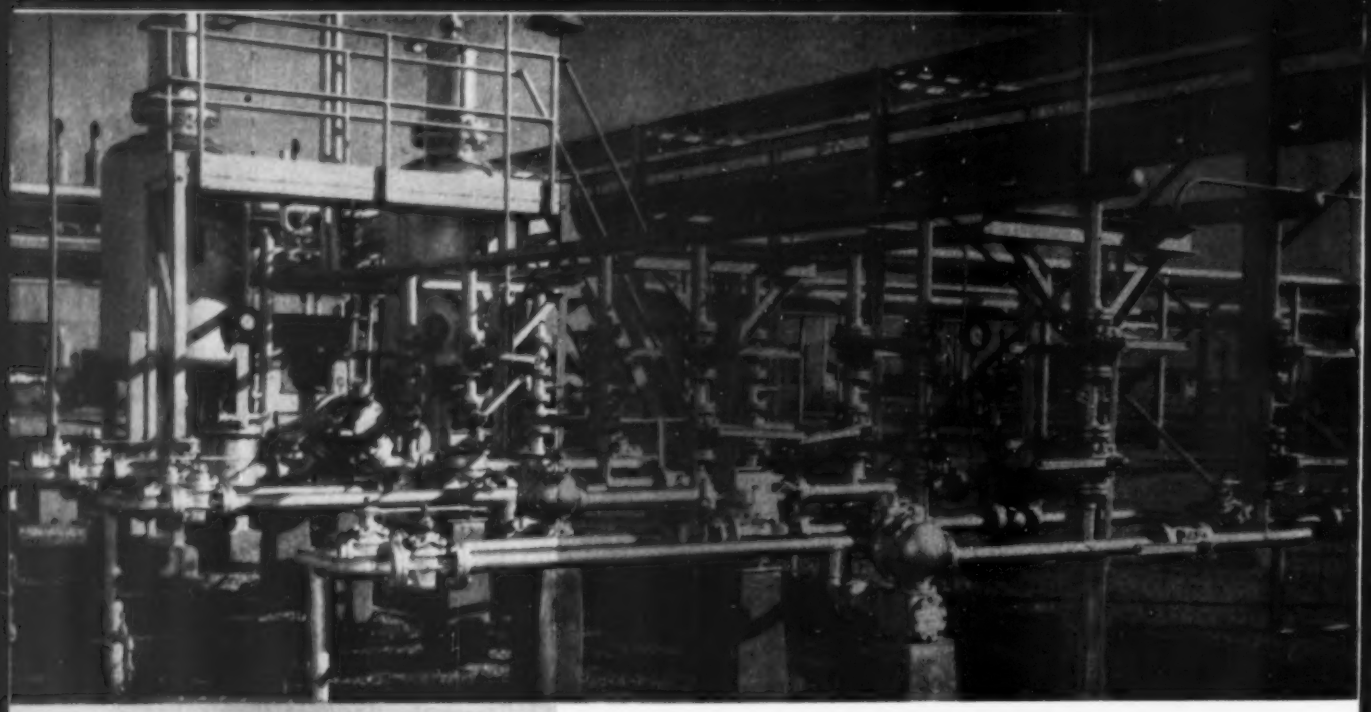
Title .....

Company .....

Street ..... City .....

Zone ..... State .....

For more data on advertised products, use Readers' Service Cards, last page.



Examine the list of analyses. Then, before you choose your new piping or tubing, get in touch with our engineers. In that way, you'll be certain to get the right analysis for your particular requirements. Our recommendations are a service to you, putting you under no obligation.

National Tube's 25 different steel tube analyses:

Carbon	5 Cr, ½ Mo	18-8
Carbon, ½ Mo	8 Cr, ½ Mo, 1½ Si	18-8 Ti
½ Cr, ½ Mo	7 Cr, ½ Mo	18-8 Cb
1 Cr, ½ Mo	8 Cr, ½ Mo	18-8 Mo
1¼ Cr, ½ Mo	8 Cr, 1 Mo	25-20
2 Cr, ½ Mo	9 Cr, 1 Mo	3½ Ni
2¼ Cr, 1 Mo	12 Cr	8 Ni
2½ Cr, ½ Mo, ¾ Si	12 Cr, Al	
3 Cr, 1 Mo	17 Cr	

WALLS WITHOUT WELDS

Refinery Tubing Problems?

We specialize in solving them

● Before you select refinery pipe and tubes, perhaps we can help you in the many problems you must face: basic differences in equipment, variations in fabricating operations, service pressure, high or low temperature conditions, presence of corrosive media, etc. Individually or collectively, all of these factors enter into determination of the best pipe or tube material for your particular service conditions.

You aren't expected to be a tubing expert—it isn't part of your job. It's ours. Our *specialty* is tubing. Through research and laboratory experimentation, through on-the-scene observations, and by studying actual installations, we at National Tube have built up an "experience file"—a collection of case histories that date back through 60 years of solving tubing problems. We want to share this experience with you.

To meet the increasingly more rigorous demands of refinery service, National Pipe and Tubes have been constantly improved until now we are able to offer you seamless tubing, condenser and heat exchanger tubes, and refinery piping in a wide range of analyses—25 of which are listed at the left. Each of these 25 analyses meets the specific requirements of corrosion and oxidation for which it is recommended. Other chemical compositions are also available in tubular products, and a wide variety of high temperature problems are now under study.

NATIONAL TUBE DIVISION,
UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS · NATIONAL SEAMLESS · PIPE AND TUBES

USS

UNITED STATES STEEL

INTERVIEW

Continued from Page 86

3. Ask how the material is going to be used.

This question can be a "tip-off" on several important points:

- Does he want to quote you directly? If he does, you may want to get clearance. In addition, his use of the material may very well temper what you say. You might express an opinion for his background information, and not to be used directly, that you wouldn't want to see in print.
- Does he want to use your company affiliation? If it's desired that your company's or organization's name be coupled with yours, again, the question of clearance may arise. Getting the matter cleared up in advance will put you on much firmer ground.

4. Should you "prepare"?

The answer is both yes and no. An interviewer has sometimes crossed an office threshold to come across the startling sight of a prepared executive, surrounded by piles of technical books, files, reports, and so on.

In the average case, such voluminous documentation is unnecessary. Generally, the interviewer wants your personal views. The kind of information he can get from reference sources he'll probably be primed on before he comes to see you.

However, where you want to refer to specific data, it's perfectly O. K. to send this along after the interview. This will conserve time—his and yours.

The matter of prepared notes is another matter, however. Let's say your public relations department has set up an interview; subject, the development your company has been making in a particular area.

Since you know the ground to be covered, there's no reason why you shouldn't have a brief outline, hitting the highlights of the story you want to tell. Your interviewer will thank you for such consideration.

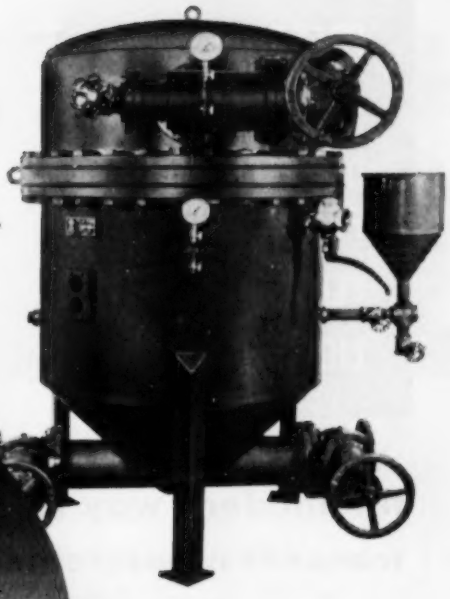
Of course, in the general press interview, where you're making a more or less detailed statement, possibly embodying a formal company policy, it's usual to follow any verbal statement by written coverage in the form of a press release.

5. Should you make it a one-man show?

Executives sometimes ponder the wisdom of having one or more assistants present during an interview. Some executives have found a good deal of stimulation value for their subordinates in such interviews.

As a rule, you can be pretty sure

this small filter...



MAKES TOUGH JOBS EASY!

Stellar® *filter*

SMALL in size and operating cost, this Stellar Filter is BIG in results and efficiency. It saves up to 75% in space and up to 90% in weight. No coagulants are used. Operation may be by unskilled personnel.

The heart of the Stellar is the Air-Bump feature which keeps the Filter clean. No wasteful back washing is required for many applications.

Oil men are using the Stellar Filter for—

★ Filtration of water or brine for flooding, repressuring or disposal purposes.

★ Filtration of cooling water and recirculating process water.

★ Removal of ferrous sulphide and other impurities from monoethanolamine in natural gas purification.

INFILCO INC. *Tucson, Arizona*

INFILCO

Plants in Chicago and Joliet, Illinois

FIELD OFFICES IN 35 PRINCIPAL CITIES IN THE U. S., CANADA AND MEXICO

For more information on how the Stellar Filter can work for you, use coupon to the right.

INFILCO INC., P.O. Box 5033, Tucson, Arizona

Please send your illustrated Stellar Filter Bulletin No. 1560-Q.

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

PRESSURE...
TEMPERATURE...
DIFFERENTIAL PRESSURE...
FLOW...
LIQUID LEVEL...

AMERICAN-MICROSEN *Electronic* TRANSMITTERS

the modern way to transmit measurements

Advances in process engineering demand modern electronic transmission of measurement signals, particularly when continuous, accurate and instantaneous response is essential.

American-Microsen Electronic Transmitters are ideally suited to the requirements of the modern processing plant and power station. They measure variables at the source — a vital factor wherever inflammable, hazardous, poisonous or corrosive liquids and gases are handled. Such materials are controlled best when closely confined.

All American-Microsen Electronic Transmitters incorporate the Microsen Balance, a unique electronic "nerve center" with a rectified oscillator output of 0.5 to 5 milliamperes that serves as the accurate transmission signal. Even under severe temperature or supply voltage variations, accuracy within ½ of 1% of scale is obtainable.

The simple, two-wire DC system of American-Microsen Electronic Transmitters eliminates the installation and maintenance cost of pressure piping. And, linear output makes it unnecessary to match transmitters and indicators. The design of all American-Microsen Electronic Transmitters also permits service in relaying and for use with potentiometer receivers.

American-Microsen Electronic Transmitters are ruggedly built for reliable performance under the most severe operating conditions. Get complete information. Write for Catalog 400A.

General Purpose Case

Vapor Proof Case

Explosion Proof Case

AMERICAN
MICROSEN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

that as far as the interviewer is concerned, their presence will be perfectly all right. He won't know—and won't care—whether they're present to back you up, or merely for purposes of executive education. After all, he's there to get information. And whatever means you use to marshal it for him makes little difference.

6. Should you ask to see copy in advance of publication?

It's a wise precaution if you're at all in doubt, or concerned with the outcome of the interview.

You may find your interviewer not too happy with such a request, particularly when he's working against short deadlines—usually the case with newspaper staff interviewers. Yet even here, if there's a question of the exact wording which will be given to your statements, you may ask to have key paragraphs read to you over the phone, once copy is in final form. In other cases, it's usually practical for you to get galley proofs with the material attributed to you marked off for your attention.

Pumping the Interviewer—Members of working press, by the very nature of their activities, tend to become pools of information on the subjects they're covering. Usually, there's no reason for you not to tap this rich source. Ask the questions that may come naturally to mind in the course of his questioning.

You may not find *his* opinion on a subject that is your specialty of interest. But often, you're one of a group of experts he's querying, and you may find it opportune to ask him about other views. He may or may not be free to name his sources. But if he asks, "Mr. White, what's your opinion of the XYZ situation?" you may very well tell him, then ask, "How does that compare with other opinions you have gotten on that point?"

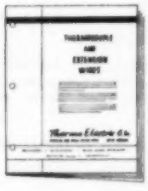
Big Time-and-Face Saver—Experienced interviewers will tell you: a lot of time and embarrassment would be saved if executives unhesitatingly confess ignorance where it exists. Of course, it isn't too easy. There's the feeling that you're being interviewed simply because you do have the answers.

To some extent we fear being in the shoes of the student who writes across his exam paper, "God only knows the answer to this question,"; and gets the reply, "God gets an A, you get an F."

In the average interview, you're "marked" only by what you say. And, "I don't know" is frequently the height of truth and wisdom.

Here's how a reel of T-E wire looks after you unwrap it. The easy-to-read label can save valuable time when you must know, and know quickly, what kind of wire is on the reel. The label tells you not only wire type, length, and polarity, but insulation colors too. Therefore, you can identify conductors easily by comparing colors listed on the label with those on the wire itself.

As you can see, it's a well-thought-out label. Important by itself, it's also a revealing illustration of the care T-E takes. Thoroughness is characteristic of every step in T-E's wire production, from drawing and calibrating to insulating. The result of such care is a product which meets high industrial standards.



There are too many T-E wires to mention comfortably in one ad. However, in T-E's 8-pg. Wire Bulletin you can see insulations, gages, and calibrations, as well as charts with calibration symbols, color codes, insulation characteristics, resistances, weights, electrical properties, and conduit capacities. Write for Bulletin 31-X.

Pyrometers • Thermocouples • Protection Tubes • Quick-Coupling Connectors
Thermocouple and Extension Wires • Resistance Bulbs • Connector Panels

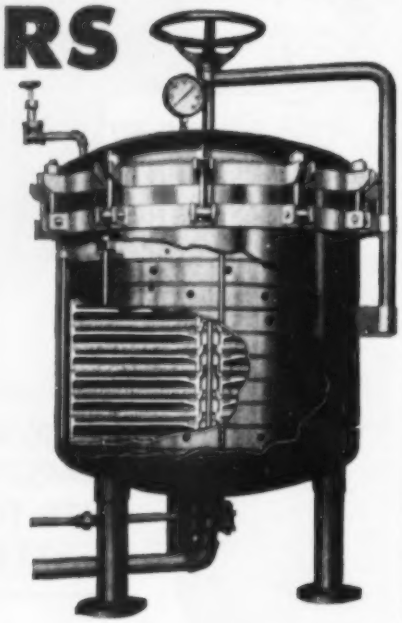
Thermo Electric Co., Inc.

SADDLE RIVER TOWNSHIP, ROCHELLE PARK POST OFFICE, NEW JERSEY
IN CANADA—THERMO ELECTRIC (Canada) Ltd., BRAMPTON, ONTARIO

For more data on advertised products, use Readers' Service Cards, last page.

SPARKLER
HORIZONTAL PLATE
FILTERS

Noted for High Quality, Consistently Uniform, Fine Sharp Filtration of Petroleum Products....



Many times Sparkler filters have been chosen by experienced filtration engineers in the petroleum field because of these specific features of superiority.

Sparkler filters deliver unusually high flow rates due to the horizontal plate construction that requires only a very thin precoat to produce fine sharp filtration right from the start. Less pressure is required with a thin precoat resulting in a filter cake of less density and high flow capacity. Intermittent operation or variation in pressures will not disturb the stability of the filter cake.

Any grade of filter paper, cloth, or screens, and any filter aid can be used with maximum efficiency because no pressure is required to hold the filter cake on the plate.

Frequently Sparkler filters are used in the petroleum industry with various grades of paper only without filter aid to perform a specific job that would be difficult or impossible with some other types of filters such as the removal of water from diesel lube oil or transformer oil.

A few typical applications of Sparkler Filters to the Petroleum and petro-chemical industries for the filtration of:

- Canned lubricating oil
- Methyl-Ethyl-ketone
- Polyisobutane
- Chlorinated hydro-carbons (carbon tet.)
- Aviation gasoline
- Jet engine fuel
- Hydraulic oil
- Gas engine & diesel lubricating oil (both continuous recirculation on the engine and batch-wise)
- Diesel fuel oil
- Cooling tower water
- Plant effluent water (to obviate stream and lake pollution)
- Removal of Raney nickel from alcohol streams
- Insecticides
- Caustics & acids
- Cottrell precipitator insulating oil (carbon black plants)

Sparkler horizontal plate filters are available in capacities from 30 to 30,000 G.P.H. depending on type of product filtered. Can be supplied in carbon steel, stainless steel, pure nickel, or monel, bronze, Hastelloy and Inconel. Rubber lined, brine or steam jacketed.

Sparkler representatives for personal engineering service are located in Dallas, Houston, San Francisco, and other principal cities. Western Branch, Los Angeles, California.

SPARKLER

Write Mr. Eric Anderson for your nearest Sparkler service representative.

MANUFACTURING COMPANY
MUNDELEIN, ILL.

Sparkler International, Ltd. Prinsengracht 876 Amsterdam, Holland

MAKERS OF INDUSTRIAL FILTERS FOR OVER A QUARTER OF A CENTURY

As Management Sees It . . .

PUBLICATION

Continued from Page 85

tion of need. It may be that the requirements of the plant can be met by merely changing the company's all-employe publication slightly or by requesting editorial emphasis in certain directions. This is more likely to be the case in smaller companies than in bigger ones. The all-employe publications issued by the latter must often deal with larger matters of company policy or with subjects of such interest that they would be read by most employes regardless of their location.

Establishment of a plant publication can be justified only where there are clearly defined objectives not covered by existing publications, or which cannot be so covered. The chief function of the plant publication must be to supplement these others with local news, local policies, local problems. Where such matters can be adequately handled without additional expense, they should be.

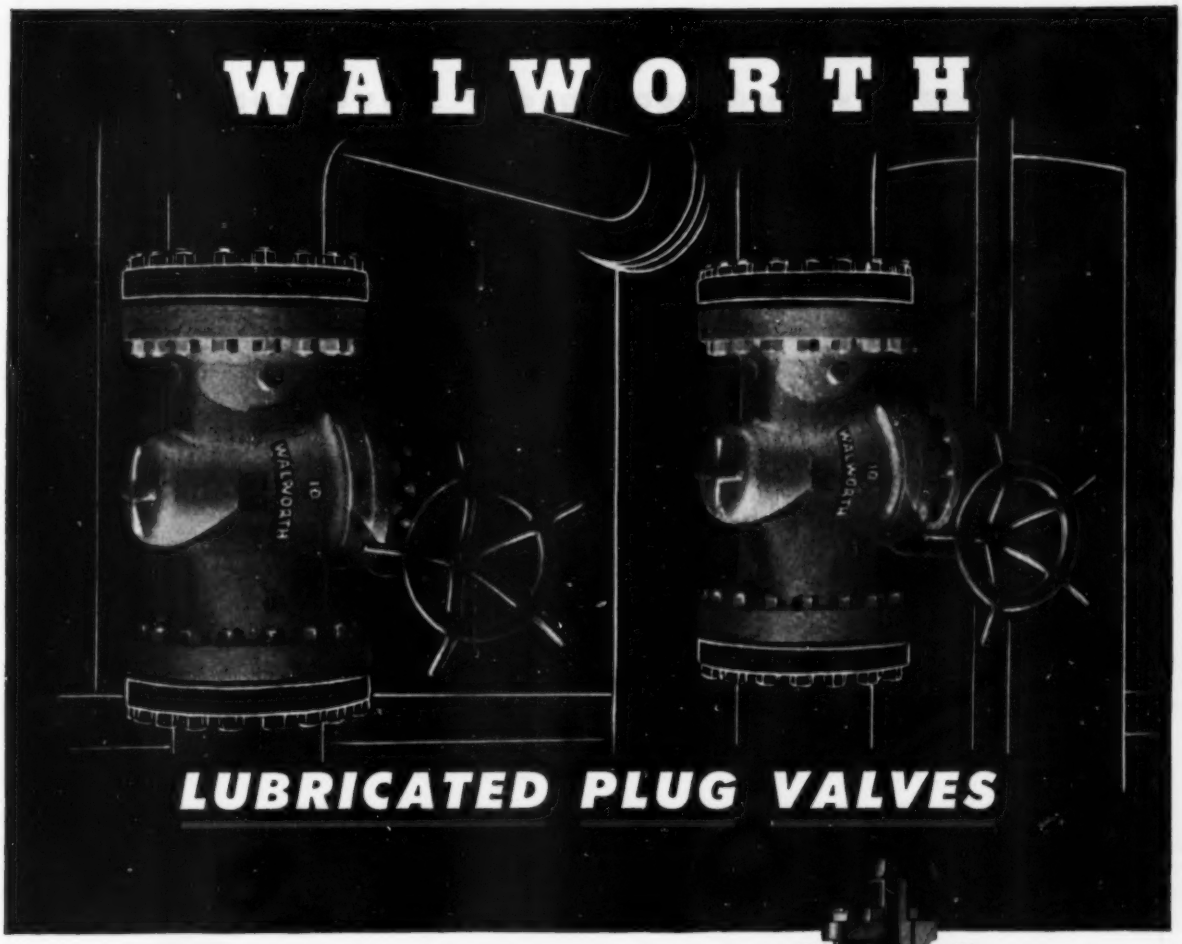
Suitability of other media should be considered. As mentioned, the bulletin board is a potential. Another is a growing use of paid advertising space in newspapers to print employe news; this has additional prestige value for "recognition" stories, has a plus factor in getting community attention, and can be economical if the community is small and newspaper rates are low. But it lacks the intimacy of the other sort of publication and has to be edited wholly for public consumption.

Management newsletters, public address systems, recorded telephone newscasts—all have their individual advantages and drawbacks. You may wish to consider them and other devices as alternates.

In evaluating your answers to the question of need, keep in mind that an employe publication offers no magic avenue to good employe relations. In those companies most successful in such relations, the employe publication generally has an important place. But it is not alone. The many other tools at the disposal of the personnel group are generally used with it. If interestingly done, it can do certain things extremely well: provide recognition for individuals or work units, explain organizational functions, promote the "we" feeling, cut down on the number of antagonistic rumors, explain management views on policies or actions, assist in getting employe cooperation and interest in fields like safety where they are vital.

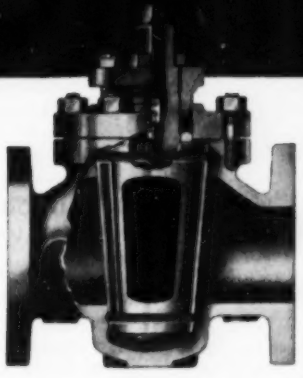
You have a right to expect aid from a publication in these and other areas. But it will not carry the load alone.

WALWORTH



LUBRICATED PLUG VALVES

Better because ... **They are *pressure sealed* with an insoluble lubricant readily renewed while the valve is in service. Lubricant completely surrounds the plug ports assuring a tight seal against leaks. It also insures ease of operation by reducing friction between the body and the plug while at the same time protecting the finished surfaces against corrosion and wear.**



Lubricant system of a Walworth No. 1700F Regular Gland, Wrench Operated, Steel-iron, *Lubricated Plug* Valve. Other Walworth *Lubricated Plug* Valves include Single Gland, and Ball Bearing types. Sizes to 30-inches — pressures to 5,000 psi, and for vacuum service.

Walworth Lubricated Plug Valves are the most satisfactory valves available for the handling of gritty suspensions, and many other destructive, erosive, and corrosive industrial and chemical solutions.

They are ideal for general refinery and pipeline service.

For full information see your Walworth Distributor, or write for your copy of Bulletin 111. Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

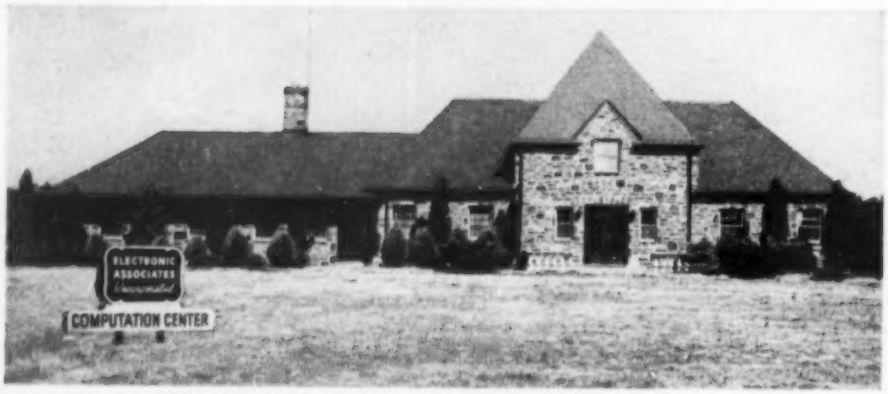
60 East 42nd Street, New York 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

For more data on advertised products, use Readers' Service Cards, last page.

EA PRECISION ANALOG COMPUTERS...
rapidly and accurately solve complex engineering problems!

Time Saving • *Money Saving*



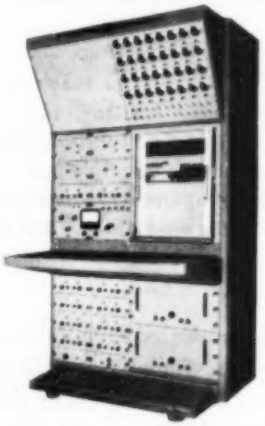
Electronic Associates Computation Center near Princeton, N. J.

At the EA Computation Center you may solve complex problems in Applications Engineering, Simulation, and Engineering design by renting EA Analog Computation Equipment by the hour, week, or month.

Scientists, engineers, and mathematicians experienced in the use of analog computers are available to assist in problem solution.

PRECISION ANALOG COMPUTATION EQUIPMENT IS ALSO AVAILABLE FOR PURCHASE.

Throughout the design of this computing equipment the objective was to produce the most accurate, versatile and dependable equipment possible at a reasonable price. In achieving this end, many of the latest advances in the art have been incorporated which contribute to the superiority of this equipment.



EA Precision Analog. Computer, Type 16-31R

If you state your interest, we will be glad to send you applicable data. Write to Dept. PR.

PRECISION ANALOG COMPUTING EQUIPMENT
FOR SOLVING PROBLEMS IN DYNAMICS

ELECTRONIC ASSOCIATES

LONG BRANCH • NEW JERSEY

For more data on advertised products, use Readers' Service Cards, last page.

As Management Sees It . . .

Better Health For Executives

Part IV
About Your Recreation

Dr. B. B. Reeve,
Medical Director,
Standard Oil Company (Indiana)

MORE THAN MOST other men do, you executives calculate risks, then act.

This executive technique has helped give the people of our nation more good things and more leisure than people anywhere else in the world have been able to achieve. More leisure time for recreation and advances in medical science have combined to improve health and lengthen lives.

You executives, however, as a group, keep on taking the calculated risk of all work and no play. True, it makes "jack," but it also makes him a dull boy, and often he drops dead.

To keep in good health, it is essential for every executive to get recreation. It's simply too important a fact of life to be neglected, or denied as a calculated risk.

For employes, executives have come to recognize the values of recreation. Time and motion studies demonstrate the costly effects of fatigue on production. Executives have found ways to make increased production pay for vacation periods, shorter working hours, longer week ends, and other recreation for employes.

But you executives have too often failed to consider the values of your own recreation. What's good for the corporate body is good for your body. In fact, recreation can work for you.

Recreation can help give you perspective. If you can become absorbed in something different from your working responsibility, even for a little while, you will return to your work immeasurably refreshed. You will find yourself studying the problems you must solve with renewed vigor—from fresh, more balanced points of view. Out under the clear sky, the solution to a big problem may become suddenly clear.

One of the best things about recreation is, of course, the freedom you have to choose interesting, refreshing things to do with your leisure time. To all the traditional hobbies, hundreds of new ones have recently been added. In fact, most of today's how-to-do-it and do-it-yourself hobbies seem tailor-made for you.

I'd suggest that you don't putter around about it. Be yourself, make up your mind to it, pick out one or two things you know you're interested in, and do something about it. While you're at it, take the calculated risk of a subject or a field that's not at all related to what your work demands you to interest yourself in. That's the way to real recreation.

If you've never tried it, you'll be surprised what wonders of recreation you can achieve for yourself in one midweek evening. And week-ends are opportunities for refreshing vacations you'll hardly believe possible.

Then there's vacation time—a real problem to many of you executives. There's only one rule to conform to: choose what you'd personally most like to do of the things you can do.

Some men do best with short vacations, some with longer ones. Others seem helped more by brief vacations at more frequent intervals. The secret is to get away from your work—completely—when you do go on vacation.

There are cautions to observe, of course.

A man who works most of the time at his desk shouldn't go out and perform physical feats beyond his capacity. If this means you, and you like to play golf, avoid fatigue rather than court it. As you grow older, especially, don't overestimate the capacity of your heart.

If you have stomach ulcers, don't misuse a vacation to do things that aggravate them. And avoid tension-type activities, whatever they are, for you.

Don't wear yourself down driving long distances a day to get to, and then back from, some resort. After all, you don't want it to be your last resort. Don't try to get a complete sun tan all in one day.

Whatever else it is, it isn't good business to come back to your work fatigued and exhausted from a vacation you've made too strenuous. Plan instead, like your real executive self, the kind of a vacation that best suits your own personal needs—and come back, refreshed.

The way to better executive health is simple:

Manage your health.

Be moderate and last longer.

This concludes the health series by Dr. Reeve.

Note: The author is dealing in generalities. He is in no way offering relief for, nor suggesting treatment for specific ailments.

3 steps to cutting maintenance time on boiler gauges

1 Check glass before installing. Is it cut evenly at both ends? Is it free from chips or scratches? Is it heavy enough for pressures you expect to use? An incorrect glass will only have to be replaced later, and the "savings" of a hurried installation will be lost.

2 Always keep two spares. When ordering gauge glasses, ask for "1 for each gauge, and 2 for the shelf." This gives you a quick, correctly sized replacement in case of emergencies. No hunting around the shop, no hurried phone calls to your distributor.

3 Don't take chances. A cheap gauge glass may save you a nickel today, and cost ten dollars in repairs. PYREX brand gauge glasses have balanced properties of heat-shock resistance, chemical stability and physical strength. You get easy reading and economical long life. Order from your Industrial Distributor today . . . and remember, two spares for every gauge.

CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Application	*Recommended Product*
Normal Conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Viewing inside furnaces, reactors pressure vessels, etc.	PYREX brand sight glasses
Lubrication inspection	PYREX brand lubricator glasses
Visible discharge devices	PYREX brand oil cup glasses

PYREX TM. REG. U.S. PAT. OFF.

CORNING GLASS WORKS
Corning, New York

Corning means research in Glass

For more data on advertised products, use Readers' Service Cards, last page.

What's Happening in the Industry . . .

Revamped Mines Bureau Will Stress Oil Research

Petroleum technical research and statistics will be emphasized in the far-reaching reorganization Interior Secretary McKay has ordered for the Bureau of Mines. At the same time, any government program to develop synthetic liquid fuels beyond the "test tube" stage will be avoided.

Changes, resulting from recommendations made by a special five-man survey team, will include the following:

- Oil shale experimental work at Rifle, Colo., will be stopped unless there is a "substantial contribution" by industry under a cooperative agreement.
- Research on synthetic gaseous and liquid fuels from coal and lignite—now being done at Morgantown, W. Va., and Bruceton, Pa.—will be confined to small scale activity and not expanded and developed into large pilot and demonstration plants.

Stanford Report Puts Smog Blame on Exhaust

The largest single source of pollutants in Los Angeles' air is motor vehicle exhaust, according to a Stanford Research Institute report which summarized a six-year study of smog.

The report estimates 3100 tons of pollutants are emitted daily into the Los Angeles basin atmosphere, of which 1500 tons are hydrocarbons. The report says automobile exhausts account for 1016 tons of the hydrocarbons emitted daily into the air.

Piercy and Shivers Draw New Assignments at Esso

George T. Piercy has been appointed assistant general manager of the Supply department at Esso Standard Oil Company. J. M. Shivers has succeeded him as manager of the Refining Coordination division.

Piercy succeeds Thomas W. Moore, who was transferred to the parent organization, Standard Oil Company (New Jersey). Shivers was transferred from the company's Baton Rouge, La., refinery, where he was manager of the Refinery Crude and Marketing division.

Shell Oil Names Hurley Houston Refinery Manager

Paul E. Hurley has been appointed manager of Shell Oil Company's Houston refinery. He succeeds M. P. L. Love, who is soon to begin a special assignment abroad.

Hurley was formerly manager of the company's refinery at Norco, La., and will be succeeded in that post by Roy W. Faulk, superintendent at the Norco refinery for the last year and a half.

Lone Star Holds Open House—

E. B. Germany, president of Lone Star Steel Company, second from left, and, left to right, Texas Commissioners W. J. (Bill) Murray, Gen. Ernest O. Thompson and Judge Olen Culberson, pause before a restored blast furnace at Lone Star's Daingerfield plant. Lone Star honored the commissioners at a program which gave Southwest oil men a look at the plant. (See story alongside.)

More Cities Now Have 94-Plus Octane Available

Number of cities in the U. S. and Canada having average octane ratings (Research) of 94 or higher for premium-grade gasolines is climbing.

The July, 1954, motor gasoline survey conducted by E. I. du Pont de Nemours & Company shows 17 cities are now in the top bracket. This figure compares with 15 in April, 1954, and nine in January, 1954.

The Du Pont survey, conducted quarterly, reports tests on samples of fuels purchased by Du Pont service representatives from retail outlets in 44 U. S. cities and six Canadian.

Little Rock, Ark., which was in a classification all by itself in the April survey with an average above 95, dropped to 94.5. Houston and Nashville had the highest ratings in the July survey with averages of 94.8.

The part of the survey covering regular-grade gasoline showed one more city moved into the 85 and above classification since April, giving an even division of 25 and 25 between cities having average octane ratings of 80 to 85 and those having ratings of 85 and above.

Commissioners Honored at Lone Star Plant Ceremony

Three members of the Texas Railroad Commission — Ernest Thompson, Olin Culberson and W. J. Murray—were recently honored for their contributions to the present day practices of conservation.

The commissioners were honored as part of a program at Lone Star Steel Company's Germany plant at Daingerfield in East Texas. The occasion was the opening of the steel plant, at which Lone Star has recently begun turning out tubular goods.

Harry Bass, president of Texas Mid-Continent Oil and Gas Association, was the principal speaker. He said of the commissioners: "These three great Texans we honor today have inspired confidence in the philosophy of oil and gas conservation."

A feature of the program was the unveiling of a pre-civil war blast furnace which has been restored.

Lyles and Case Head New CNGA Officers

A. C. Lyles, senior gas engineer, General Petroleum Corporation, has become president of the California Natural Gasoline Association.

The new president has served in many capacities since becoming a member of the association in 1927. He served on the board of directors for five years prior to becoming vice president in 1953.

New vice president of CNGA is C. L. Case, of Continental Oil Company.

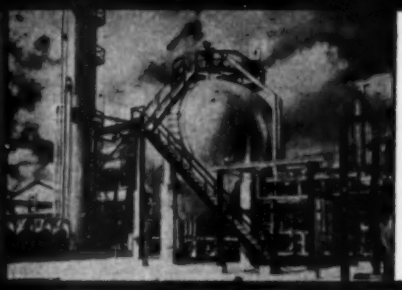
Members of the directorate elected for a two year term, 1954-1956, were: M. L. Arnold, Richfield Oil Corporation; F. W. Borden, Sunray Oil Corporation; R. O. Boykin, Fullerton Oil Company; A. H. Bradford, West Coast Refining Company; F. E. Bradley, Chanslor-Western Oil & Development Company; P. E. Beckman, Pacific Gas & Electric Company; John S. Bell, Humble Oil Company; L. V. Cassaday, Lomita Gasoline Company; W. F. Crane, Pacific Western Oil Company; J. T. Doyle, Shell Oil Company; H. L. Eggleston, Analyst; P. E. Foote, Petrolane, Ltd.; John Hancock, Hancock Oil Company; Fred L. Hartley, Union Oil Company of California; R. J. Hull, California Research Corporation; C. L. Hutchings, Tide Water Associated Oil Company; M. W. Kibre, General Petroleum Corporation; C. B. Kimberlin, Seaboard Oil Company; Wm. A. Kirk, Jr., Pacific Coast Gasoline Company; H. J. Maxwell, Standard Oil Company of California; Geo. C. McLaren, Standard of California; N. H. Mull, The Texas Company; H. W. Parmelee, Consultant; H. M. Paulsen, Bankline Oil Company; W. W. Robinson, Jr., Texaco; L. C. Rowson, Texaco; D. A. Smith, Tide Water; George Sowards, The Ohio Oil Company; H. D. Spiers, The Superior Oil Company; A. J. Sullivan, Standard of California; J. B. Taylor, Signal Oil & Gas Company; R. S. Tulin, Retired;

TO INCREASE REFINING EFFICIENCY

PETRECO

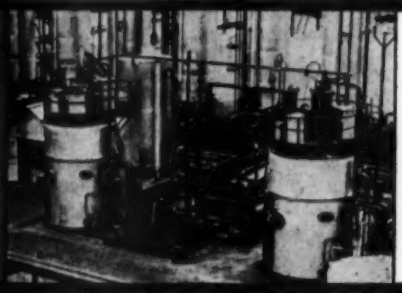
ELECTRIC PROCESSING

DESALTING



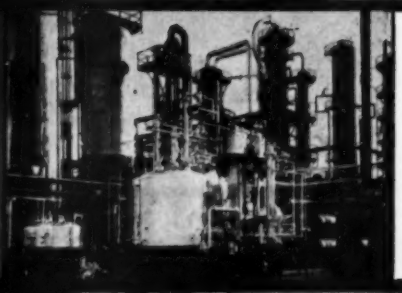
Petreco *Electric* Desalting eliminates salts, solids, and other impurities with such a high degree of efficiency that salt difficulties are eliminated – *enabling refiners to run more crude.*

LUBE OIL TREATING



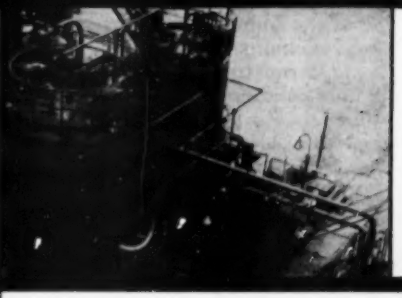
Petreco Lube Oil Treating is an automatic, continuous method for acid-treating lube oils and similar stocks. It is carried on in a closed system, under pressure. High efficiency acid contacting results in minimum acid usage, negligible oil entrainment in sludge, and maximum product quality.

DISTILLATE TREATING



Petreco *Electric* Distillate Treating takes the guesswork out of distillate treating. It is applicable to acid, alkali or doctor treating all distillate stocks. It permits continuous, automatically controlled treating with minimum equipment, handling and attention.

DESAPONIFICATION



Where caustic is added to crude prior to distillation, ash-forming materials resulting from such caustic are often present in fuel stocks. Petreco *Electric* Desaponification removes about 85% of such ash-forming constituents, enabling fuel stock to be marketed or used as a cracking charge.

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PETROLEUM PROCESSING

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SEDIMENT SEPARATING
DISTILLATE TREATING
DESAPONIFYING

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For more data on advertised products, use Readers' Service Cards, last page.

Insure "cracking good" production

Give small as well as large tubes in your plant thorough, periodical cleaning and overhaul with Airetool Tube Maintenance Equipment . . . you can safely carry on peak production for longer periods without danger of breakdown during high-priority runs.

. . . with AIRETOOL tube maintenance equipment

CLEAN

. . . small-diameter condenser and heat exchanger tubes quickly and efficiently . . . even those completely choked with hardest deposits, with Airetool Condenser Cleaners. Geared or direct drive . . . air or electric motors . . . flushing device keeps drill head cool at all times. A full variety of drill, reamer and brush cleaner heads are available.

EXPAND

. . . tube joints in condensers and heat exchangers in less time . . . to a uniform tightness with maximum bonding between tube and tube sheet. Precision-made, ball bearing Airetool Tube Expanders roll tubes to 2½" I.D.; the Airetool Tube Expansion Control System saves time . . . eliminates "over-rolling."

Write for complete information on Airetool Tube Cleaning and Expanding Equipment

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New York, Philadelphia, Houston, Chicago, Tulsa, Baton Rouge.

Representatives in principal cities in U.S.A., Canada, Mexico, South America, England.

What's Happening. . .

Lyles

Case

Geo. L. Tyler, E. I. du Pont de Nemours & Company; and D. M. Wolfe, Standard of California.

Holding over and serving as directors until 1955 are: E. C. Cunningham, Wilmington Gasoline Company; J. R. Fluor, The Fluor Corporation, Ltd.; M. L. Fort, Pacific Lighting Gas Supply Company; C. D. Gard, Union Oil; R. W. Heath, Signal; A. K. Hegeman, Clark Bros., Inc.; J. C. Herron, Shell Oil; Basil Kantzer, Union Oil; Wm. A. Kirk, California Southern Oil Company; Warren H. Kraft, Honolulu Oil Corporation; Grove Lawrence, Southern California Gas Company; L. V. Leonard, Shell Oil; S. F. Magor, Superior Oil; P. S. Magruder, General Petroleum; F. M. Perry, Cities Service Oil Company; C. M. Sandland, C. F. Braun & Company; J. A. Smith, Texaco; R. W. Todd, Pacific Lighting Gas Supply; E. W. Walker, Western Gulf Oil Company; and L. M. Windle, Richfield.

The following were elected as chairmen of the three branch chapters of the association: A. A. Quarnstrom, Richfield, Taft; L. A. Seward, Pacific Lighting Gas Supply, Coastal; and F. E. Huff, Standard of California, San Francisco Bay Area.

E. R. Millett, Jr., was again appointed secretary-treasurer for the 1954-1955 fiscal year.

IPRA Holds Meeting to Discuss Industry Problems

An emergency meeting of the Independent Refiners Association of America was held last month in Denver. The meeting was called by M. H. Robineau, president of the association and president of The Frontier Refining Company, because of "the alarming acceleration in the rate of deterioration in the petroleum industry in recent weeks."

The meeting was adjourned for three weeks after a lengthy and vigorous discussion of industry problems in general. It will reconvene in Chicago August 11.

Topics discussed included preferential pipe line tariffs for shipper-owners, discriminatory royalty processing fees, the depletion allowance and its effect on the refining industry, as well as the general import and over-supply situation.

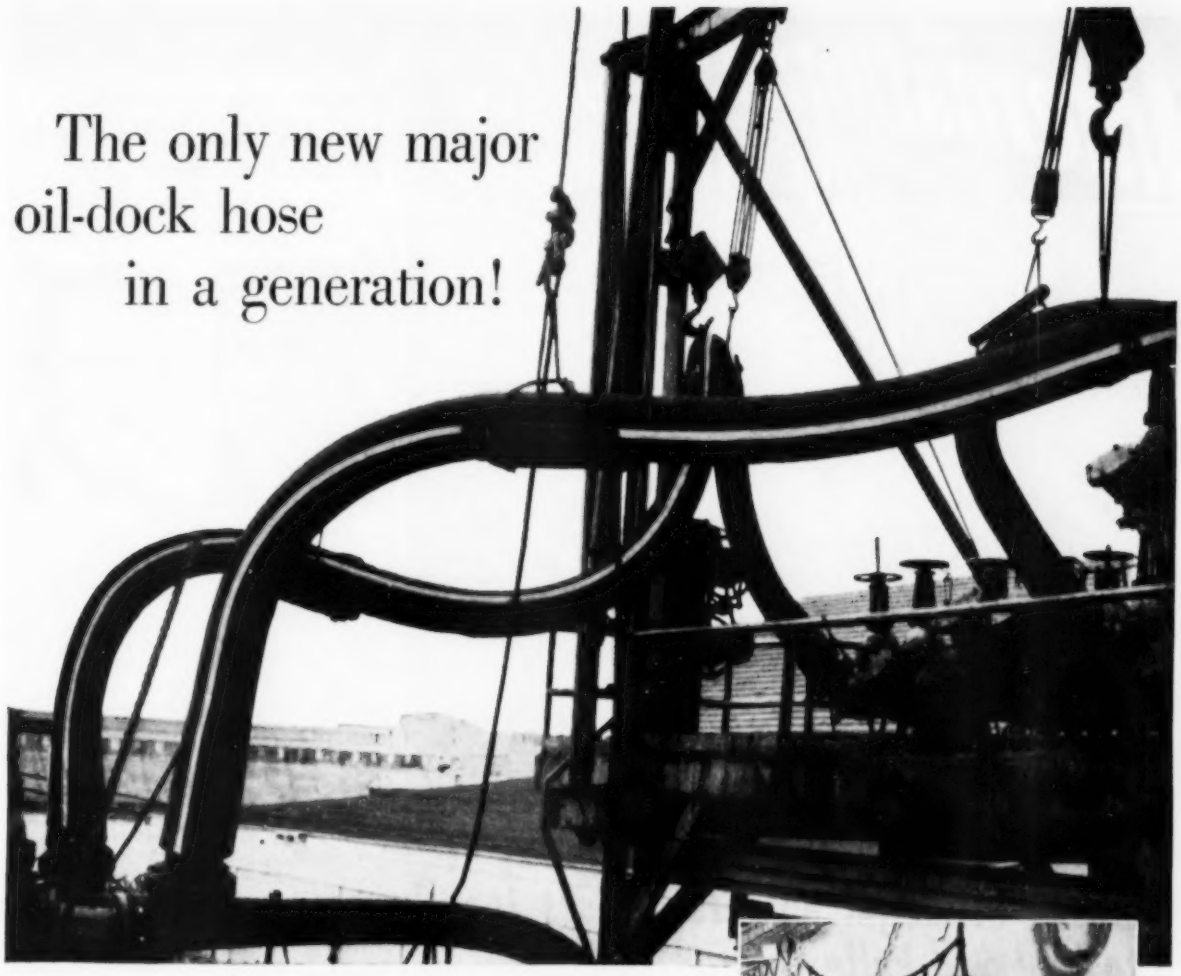
Champlin Executive Resigns

George E. Leverton has resigned as executive vice president of Champlin Refining Company after 30 years with the company. He has been succeeded by J. L. Rune.

Leverton will now devote his full time to the private business interests of Joe N. Champlin, who recently sold his re-

For more data on advertised products, use Readers' Service Cards, last page.

The only new major oil-dock hose in a generation!



The U. S. Amazon® H-1515 weighs ⅔ less than conventional dock hose!

No more bothering with heavy, stiff hose that's hard to handle and hoist. No more wasting 30 minutes or over in make-up time to a header (with dock charges running as high as $200 an hour or more). Get it done with U.S. Amazon H-1515 in 5 minutes. Four years of Navy service and up to three years' use by every major oil company in America and in most foreign countries have proved conclusively that U.S. Amazon puts conventional oil-dock hose back into the horse-and-buggy age.

Note these facts:

● No more delays from accidents caused by handling heavy hose and fittings. ● Weighs 2/3 less than conventional hose. End fittings also weigh 50% less. ● Flexibility? U.S. Amazon H-1515 has a semi-rigid construction which remains undamaged by the folding and flattening encountered in ordinary hose use. ● Oil companies, barge and towing lines from coast to coast praise its economy and order more U.S. Amazon H-1515. Dock workers are outspoken in their praise, and like to work with it. U.S. Amazon H-1515 is made by United States Rubber Company, and is sold through any of the 27 "U.S." District Sales Offices. Further information is obtainable by writing to address below.

The light weight of H-1515 makes it the only dock hose that should be used for hard-to-reach bunkering headers. Photo shows a connection being made without the need for a hoist.

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"U.S." Research perfects it . . . "U.S." Production builds it . . . U.S. Industry depends on it.

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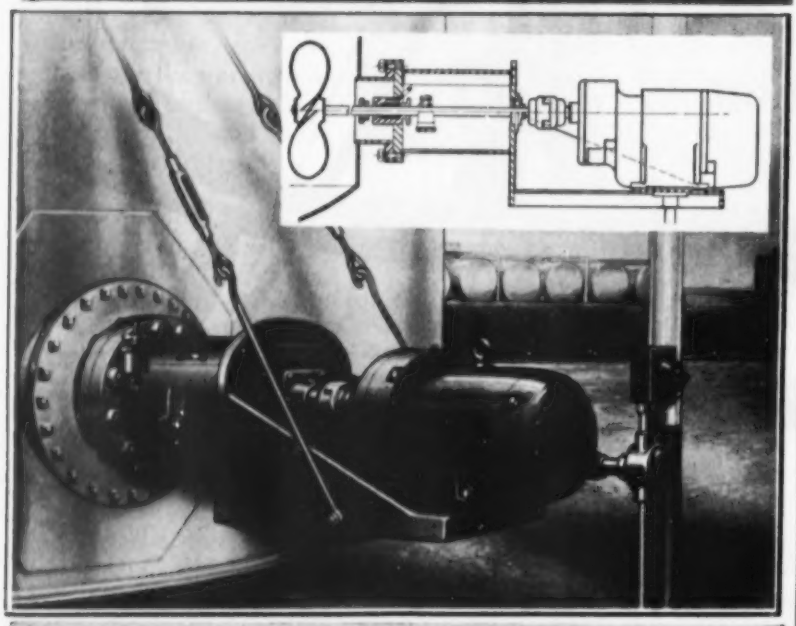
For more data on advertised products, use Readers' Service Cards, last page.

International's Type "NU" SIDE ENTERING MIXER



Wins fast acceptance! Users say it meets all requirements. Costs less to buy and Fully Guaranteed!

Here is a mixer that has no cast parts, being of all-welded construction, including the stuffing box,—nothing to break or get out of order. And due to its strong, simple construction it is replacing many complicated, and higher priced units. It is recommended for the most efficient, rapid and economical blending of gasoline, gasoline Ethyl mixing, lubricating and fuel oil blending as well as by-products. Indispensable in cycling operations and pipe line work—uniformity in charging stock—a natural for research, laboratory and pilot plants.

12 SIZES—FROM ½ TO 25 H. P.

This unit has two ball bearings, and a front single lantern bearing on the shaft, thus giving three bearing supports to the overhung propeller shaft. Quick access to the front ball bearing and the stuffing box gland is obtained by opening the hinged cover door on top. Repacked from outside without tank leakage. . achieved by the same positive arrangement as our other models.

If you have a mixing problem, we invite you to write us for Catalogs and any special Engineering information you may need. There is no obligation of course.

Look to **International**
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What's Happening. . .

finery to Chicago Corporation.

Halpern Heads Changes in Texaco Executive Staff

A senior vice president and three vice presidents have been elected at The Texas Company.

Halpern

Worden

Holmes

M. Halpern, vice president in charge of refining, has been elected senior vice president, a new executive post.

J. S. Worden, former general manager of refining, has been elected vice president, succeeding Halpern.

F. H. Holmes, former assistant general manager of refining, has been elected vice president in charge of the Research and Technical department, also a new executive post.

T. E. Buchanan, general manager of the Marine department, has been elected a vice president.

Humble Promotes Andrews At Baytown Refinery

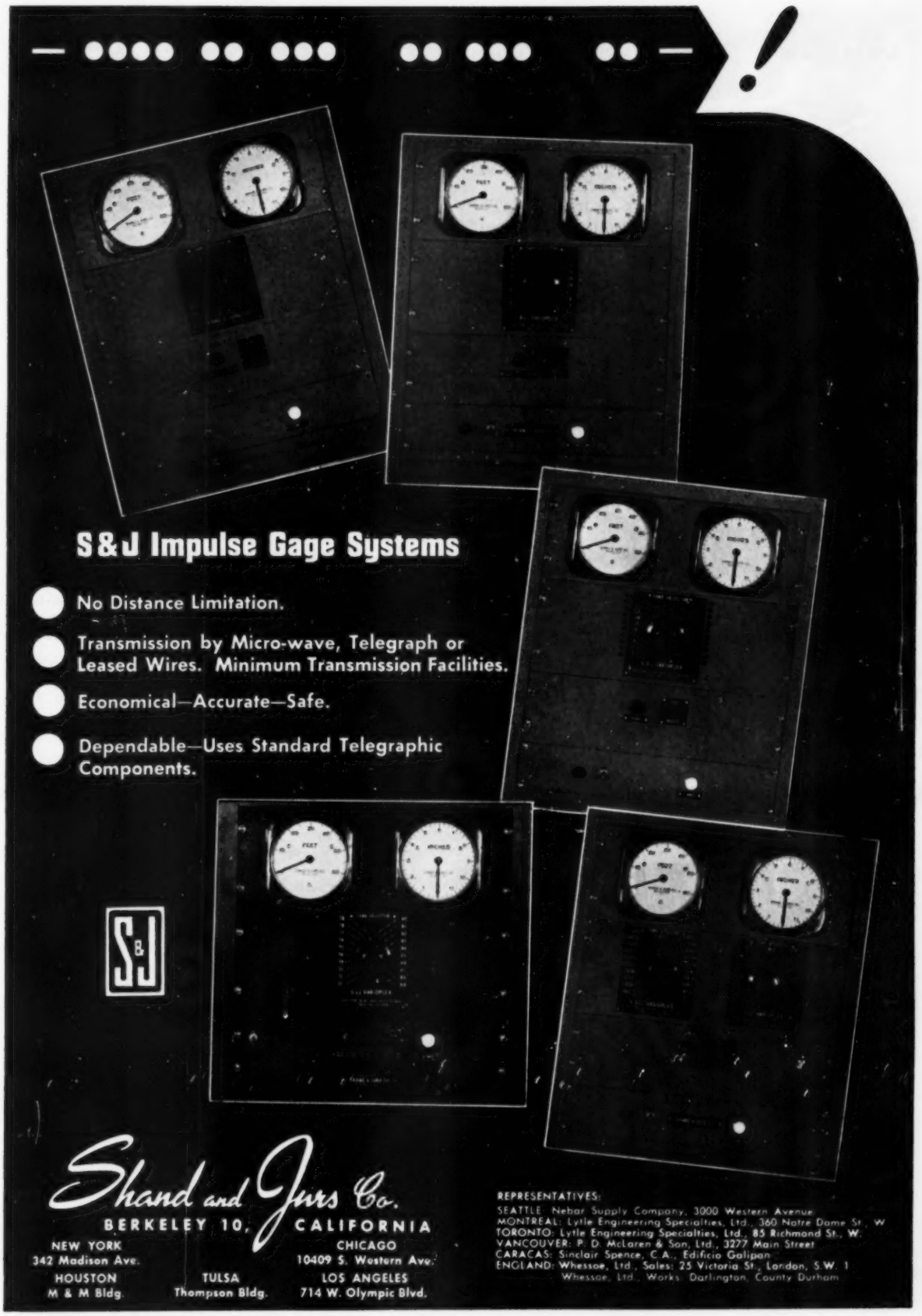
Jack M. Andrews has been promoted to senior research chemist in the Research and Development division at Humble Oil & Refining Company's Baytown, Texas, refinery. In his new post he will be concerned primarily with investigations in the field of catalytic cracking and the fluidized solids technique.

Rister Plans Writing of Centennial History of Oil

Carl Coke Rister, distinguished professor of history at Texas Technological College, has undertaken to write a centennial history of the American oil industry for 1959. Oil men, he says, can help immeasurably by making available to him such materials as oil publications, articles, maps, photographs, and out-of-print books. Rister explained that his new undertaking will be a treatment of the oil industry similar to his *Oil! Titan of the Southwest*, but will be on a larger scale.

Pure Oil Promotes Two

P. N. Gammelgard, general manager of refining, has been promoted to vice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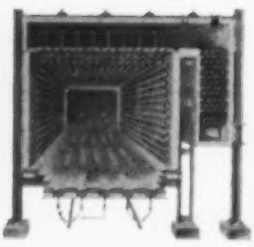
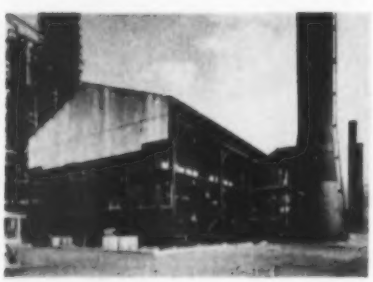
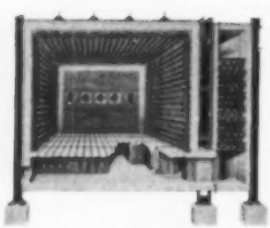
LUMMUS

OIL HEATER DIVISION
385 Madison Avenue, New York 17, N. Y.

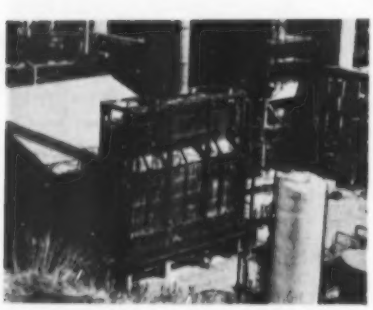


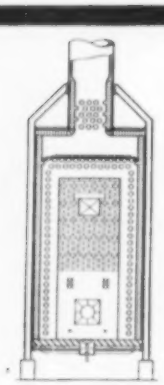
Lummus Standard Oil Heaters are made in two basic types. The up-take heater, illustrated at the left, conducts the products of combustion upward from the entire heating chamber at low and uniform levels of velocity.





The down-take heater, illustrated at the left, is suitable for service where products of combustion would contain corrosive elements or solid matter. It draws hot gases downward from the combustion chamber through the diffusion baffles. Both types of Lummus Standard Heaters are adaptable for multi-coil or multi-stage heating.





The Economy Heater, illustrated at the left, finds wide application in smaller refineries where the investment necessary for extensive maintenance platforms and roofing is not justified. The flexibility and variety of capacities available with multi-coil and multi-stage settings can be obtained with Lummus-Built Heaters in the same manner as with the larger Standard units.

Lummus Standard Oil Heaters and Lummus-Built Heaters are the answer to the vital problem of supplying process heat in any required amount for petroleum refineries, chemical and petro-chemical plants. Single Lummus Heaters are operating at continuous heat absorptions ranging from 100,000 to 300,000,000 BTU per hour. Lummus has designed and installed heaters for use with every major process.

BRANCH OFFICES — Houston: 2707 Weslayan Rd., Houston 6, Texas • England: The Lummus Co., Ltd., 80 Regent St., London W1, England • France: Societe Francaise des Techniques Lummus, 39 Rue Cambon, Paris 1er, France

LUMMUS

OIL HEATER DIVISION
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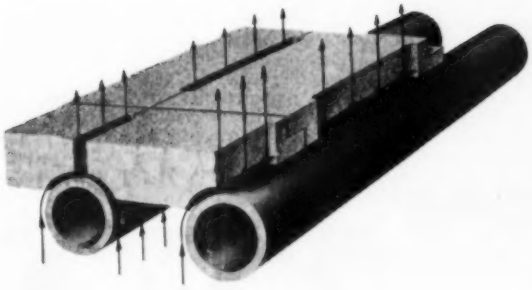
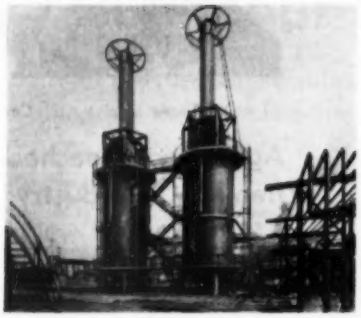
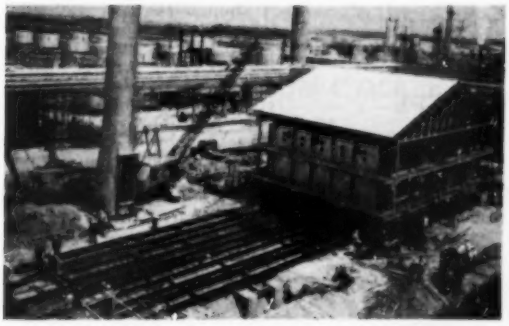


The patented gas diffusion baffle arrangement shown at the left is characteristic of Lummus furnaces. This arrangement creates a draft resistance or dampering effect which assures uniform evacuation of the products of combustion over the entire ceiling area of the combustion chamber.

Benefits obtained by the use of the slotted refractory baffle tile include high velocity gas flow over the shielded upper row of roof tubes—with consequent high convection heat pick-up—and re-radiated heat from the under side of the tile to the upper side of the bottom row of roof tubes.



Lummus-Built Heaters incorporate the same material, mechanical and operating advantages of the Lummus Standard Oil Heaters but are built along the more simplified and economical lines possible with their smaller size. The Lummus Vertical Tube Heater, illustrated at the left, for milder heat requirements, is especially designed for limited space installation.



The portable heater, left, was built for Magnolia in record time—a mere six weeks downtime compared with the usual five months. It is the height of flexibility and is a smooth-running 100,000,000 BTU per hour heater handling 36,000 B/D of charge stocks—an increase of several thousand barrels over the heater it replaced.

The heaters described above are, of course, Lummus designed. Lummus also has built and will build for you, if requested, counter-parts of all popular types of furnaces used in the petroleum, chemical and petro-chemical industries. Lummus can also build to your specifications any type of specialty heater that a particular production problem calls for. Lummus' 50 years of experience in constructing petroleum and chemical plants lies behind the work of the Oil Heater Division, providing the knowledge necessary to do any job requested by a customer—and to do it right.

BRANCH OFFICES — Chicago: 600 South Michigan Ave., Chicago 5, Illinois • Venezuela: Compania Anonima Venezolana Lummus, Edificio "Las Grandillas", Esquina Las Gradillas, Caracas, Venezuela • Canada: 455 Craig St. West, Montreal

For more data on advertised products, use Readers' Service Cards, last page.

What's Happening. . .

president of refining at The Pure Oil Company, and Dr. Kenneth M. Watson, director of research, has been elected vice president of research and development.

Conoco Goes Six Years Without Fatal Accident

Continental Oil Company has completed six years of operations without a fatality. The new record represents 115,769,842 man-hours worked without a fatality. Among the leaders in accident prevention in the oil industry for many years, Conoco has won 44 accident prevention awards in National Safety Council competition.

Heine Tops Promotions at Phillips Petroleum

M. B. Heine, general purchasing agent of Phillips Petroleum Company since 1948, has been promoted to manager of the Purchasing department. J. W. Proffitt, formerly assistant general purchasing agent, succeeds Heine as general purchasing agent. These changes were made upon the retirement of H. E. Koopman, vice president in charge of the Purchasing department since 1927.

Other promotions announced by Phillips include C. W. Patchen, from buyer to assistant general purchasing agent; R. L. Robertson, L. E. Shultz and R. P. Leisure, each from buyer to senior assistant purchasing agent; and D. E. Hynes, from material coordinator to buyer.

Carson-Wolf Formed as New Construction Concern

Carson-Wolf Corporation, a new firm, has been formed to become constructors for the petroleum, natural gas and chemical industries. The corporation will maintain office in the Melrose Building, Houston.

President of the firm is O. L. "Kit" Carson, until recently general manager of Tellepsen Petro-Chem Corporation. Vice president is Paul F. Wolfinger, who was Southern division manager of Midwestern Constructors, Inc., prior to taking over his new position.

The president and vice president of Carson-Wolf represent approximately 30 years of construction experience, in the natural gas, crude oil and products pipe line, refining and natural gasoline industries.

Wolfinger Carson

Agreement Reached on Iranian Oil Industry

Representatives of eight international oil companies and Iran have reached an agreement in principle to put Iranian oil back on world markets. Finance Minister Ali Amini announced that a separate agreement on the compensation issue between Iran and British-owned Anglo-Iranian Oil Company is still to be finally approved. Iran would pay $84 million exclusive of the Abadan refinery.

Though the negotiating stage of the initial phase of this issue has been passed, operation of the industry which has been idle for 3½ years is far from being on calm water. The plan for the consortium to operate the industry still must win approval in the Majlis, where there has been mounting opposition to any plan that would mean foreign operation of the oil industry.

The consortium plan is for output of 250,000 barrels a day from Iran during the first year of operation, with increases scheduled to push the capacity to almost 525,000-plus barrels a day within three years.

John Pew Dies at 83

John G. Pew, a director of Sun Oil Company and former president of Sun Shipbuilding & Drydock Company, died recently at his home in Rose Valley, Pa. He was 83.

Ethyl Hangs Portrait of Scientist Thomas Midgley

A new portrait of the late Thomas Midgley, Jr., noted scientist whose discovery of tetraethyl lead as an anti-

TULSA TYPE

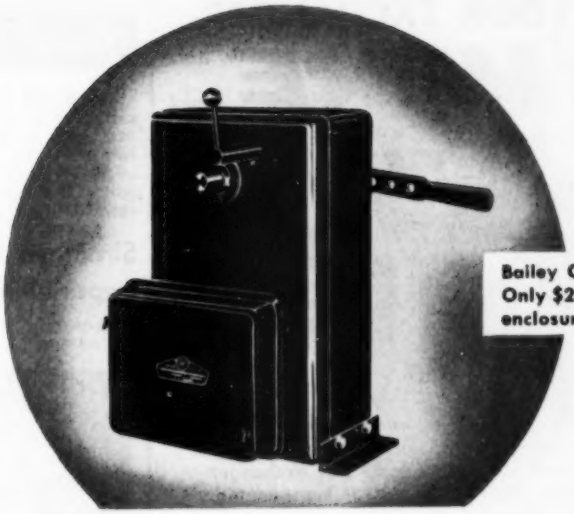
HOW TO FEEL YOUNG AT 40

FLINT STEEL CORPORATION is a 40-year old firm, but we're still youthful in our outlook and ability to get things done. We retain our youth by keeping up with all the latest developments in steel plate fabricating with modern equipment. And, we've been fabricating specialized TULSA TYPE equipment for the petroleum and petrochemical industries for 30 years. This combination of long experience and modern machines goes to work for you whenever you call on FLINT STEEL. We earnestly invite you to discuss your plate fabricating problems with us at any time.

Write for our General Catalog

BUILT Right

FLINT STEEL CORPORATION
TULSA, OKLAHOMA



Bailey Control Drive, Type AC44P Model 200. Only $210.00 F.O.B. Cleveland, complete with enclosure, positioning relay and hand operator.

Want Better Flow Characteristics from Your Regulating Devices?

This new, small, piston-operated Bailey Control Drive will improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders and similar regulating devices. Adjustment is simple; any desired relation between drive motion and pneumatic signal may be secured.

You can install this compact pneumatic drive power unit in any position on a column, pipe, or flat surface—and connect it to the regulating device with standard Bailey linkage, available from stock.

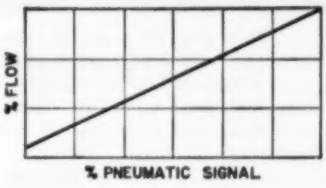
Speed (time required for full travel) is adjustable to suit your requirements. Bailey Control Drives operate on standard SAMA pneumatic signal ranges of 3 - 15 or 3 - 27 psig.

AVAILABLE FROM STOCK in 3 standard sizes

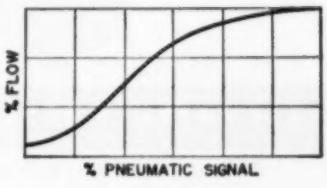
Type	Piston Dia. Inches	Piston Stroke Inches	Torque ft-lb	Max. Travel Degrees	Approx. Dimensions Inches
AC816	8	16	1500	90	13 x 27 x 51
AC68	6	8	400	90	13 x 19 x 34
AC44	4	4	75	75	10 x 11 x 19

P-28

The New Bailey Control Drive gives you THIS—



instead of THIS



BAILEY METER COMPANY

1043 IVANHOE ROAD

CLEVELAND 10, OHIO

Complete Controls for Process Plants

BAILEY METERS

Controls for

TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW LEVEL
RATIO

FOR MORE INFORMATION
FILL OUT AND MAIL

☐ I am interested in Bailey Control Drives. Mail me Spec. CA44C

☐ I am interested in Bailey Control Linkage. Mail me Spec. CA943C

Name _____

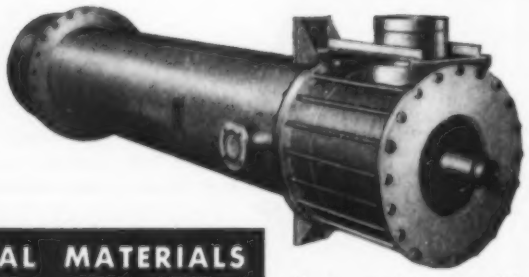
Title & Company _____

Street & Number _____

City & Zone _____ State _____

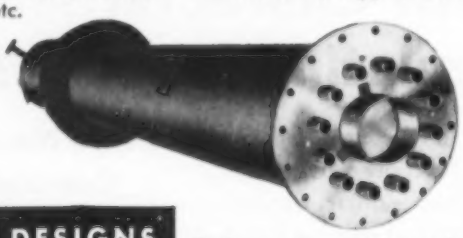
For more data on advertised products, use Readers' Service Cards, last page.

THE ANSWER TO YOUR EXCHANGER PROBLEM MAY BE *HERE*



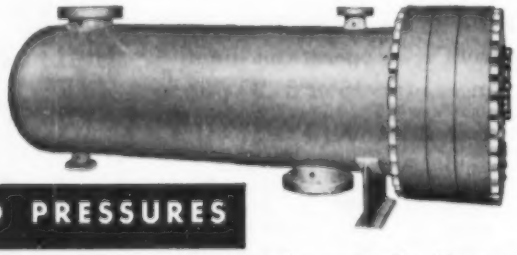
SPECIAL MATERIALS

If your requirements call for special materials of construction, Whitlock can help you. Here's just one example — a graphite tube side, steel shell side exchanger. This exchanger utilizes chemically inactive graphite which has been resin impregnated. Units of this type are particularly adapted to process operations where highly corrosive fluids must be handled. We also regularly work with other anti-corrosive materials: stainless steel, copper, nickel, Monel, Hastelloy, etc.



SPECIAL DESIGNS

Perhaps you need special design techniques — if you do Whitlock can help you. For example, this falling film evaporator (with top channel removed) was carefully designed with a maximum elevation difference in tube ends of plus or minus 0.005" to assure proper feed distribution to individual tubes. Whitlock Engineers are thoroughly experienced in designing exchangers for difficult operating conditions.



ELEVATED PRESSURES

Perhaps you need an exchanger for elevated pressures like this rugged cooler, built for design pressures of 600 p.s.i.g. on both shell and tube sides. Its "Monobloc" (solid disc) channel is about 7" thick to take care of the working pressure. The 1" thick shell was stress-relieved after fabrication. We are regularly manufacturing shell and tube units (for pressures to 3000 p.s.i.g.) and shell and coil units (for pressures in excess of 5000 p.s.i.g.).

Whitlock

For recommendations write The Whitlock Manufacturing Company, 75 South Street, West Hartford 10, Conn.

Designers and builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

What's Happening. . .

knock agent led to formation of Ethyl Corporation, was unveiled recently in a ceremony at the Ethyl Research Laboratories in Detroit. The portrait, a work of well-known artist Thomas E. Stephens, will hang in the lobby of the laboratories' main building.

Simmons Becomes Head of Imperial Manufacturing

Imperial Oil Ltd. has named Dwight S. Simmons as general manager of the

Simmons

Cogan

Manufacturing department. He succeeds G. L. MacPherson, who has been elected a member of the board of directors. Simmons will be succeeded as assistant general manager of manufacturing in charge of refinery planning and engineering by J. A. Cogan, who for the past seven years has been manager of the Coordination and Economics department of Standard Oil Company (New Jersey), parent company of Imperial.

LPG Testing Methods to Be Subject of Symposium

A Symposium on Methods for Testing Liquefied Petroleum Gases will be held September 27-28, 1954, at the Statler Hotel in St. Louis, Mo. It will be sponsored jointly by ASTM Committee D-2 on Petroleum Products, ASTM Committee D-3 on Gaseous Fuels, the Natural Gasoline Association of America and the California Natural Gasoline Association. It will consist of two full days of technical papers and a display of specialized LPG testing equipment.

Form New British Concern

Oronite Chemical Company and Distillers Company, Ltd., have announced the formation of Orobis, Ltd., a jointly owned British corporation now constructing a plant for the manufacture of lubricating oil additives at Hull, England.

A complete line of lubricating oil additives as manufactured by Oronite in the U. S. will be manufactured and marketed by the new company. It is expected that the plant will be in operation by the end of this year.

Patent Attorney Named

Michael Dufinecz, Jr., has been appointed a patent attorney in the Development and Patent department of Standard Oil Company (Indiana). He joined the Research department in 1938 and since 1951 has been a patent solicitor in the Development and Patent department.

What's Happening. . .

Houdry Advances Daft To Vice President

George H. Daft, treasurer, comptroller, and a director of Houdry Process Corporation, has been elected vice president in charge of finance and accounting.

Daft

Daft served on the accounting staff of Sun Oil Company for a number of years before transferred to Houdry in 1940, assuming the position of office manager and chief accountant. In 1944 he became comptroller, and in 1948 he was elected treasurer and a member of the board of directors.

Daft is a member of the board of directors of the Philadelphia Control of Controllers Institute.

Humble Lecture Series Will Include Three Short Courses

The second annual Humble Lectures in Engineering series at Humble Oil & Refining Company's Baytown, Texas, refinery will include three two-week courses. The first, in Mechanics and Strength of Materials began in July and is taught by Professor Dana Young, chairman of the Department of Civil Engineering at Yale University. In September, Professor H. H. Uhlig, director of the Corrosion Laboratory at Massachusetts Institute of Technology, will instruct a class in Corrosion. The final course will be in Metallurgy and will be presented in December by Professor J. W. Freeman of the Department of Metallurgical and Chemical Engineering at the University of Michigan. Both Professor Young and Professor Freeman conducted similar courses in last year's Humble Lectures in Engineering series.

Du Pont Employes Achieve Quarter Century of Safety

Employes of the E. I. du Pont de Nemours and Company, Inc., Rubber Laboratory, Deepwater Point, N. J., have achieved the enviable record of going a quarter of a century without a single lost-time injury.

This is the longest injury-free time span recorded to date by any unit of the du Pont Company, current holder of two world safety records in plant operations and construction.

Last year, according to National Safety Council figures, one out of every 20 Americans was killed or suffered a disabling injury on "off-the-job" time. Viewed from the recently set record, the employes of the Rubber Laboratory are 90 times safer on the job than the average American is on his "off-the-job" time.

Since July 1, 1929, the day the Rubber Laboratory first opened, it has operated more than 3,200,000 man-hours without

Get the Full Story on versatile, economical dbpc® antioxidant

A remarkable inhibitor, **dbpc** antioxidant, has so many applications that it takes a booklet to tell the whole story. Koppers booklet does just that.

This product, known chemically as di-tert-butyl-para-cresol, has many diversified applications, including foods, plastics, and petroleum products, such as gasoline, insulating oils and lubricants. Each section is fully and interestingly illustrated.

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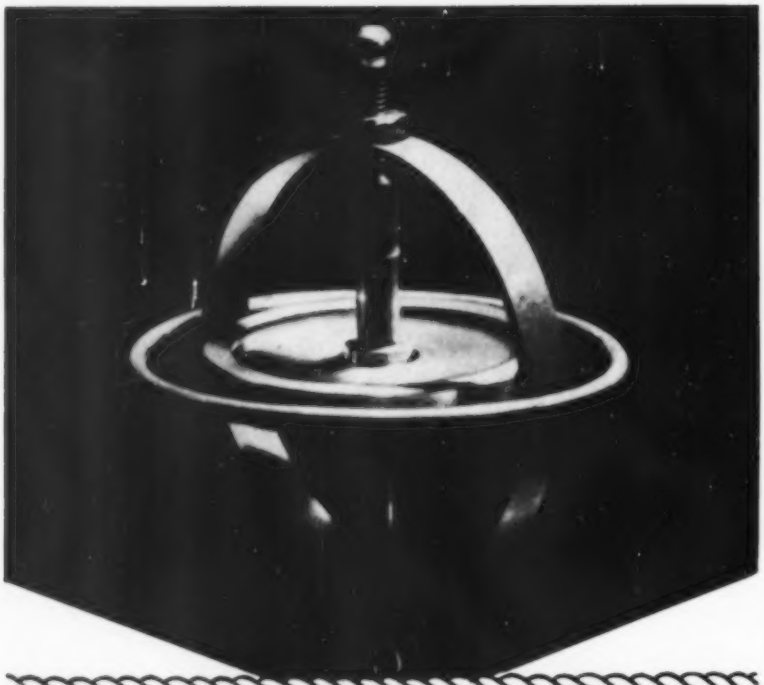
KOPPERS® Koppers Chemicals

For more data on advertised products, use Readers' Service Cards, last page.



BALANCE

For *true worth* the cost of industrial insulating materials and installation should be balanced against the efficiency and life of the insulation.

First cost may be a deceptive indicator of insulation value. You may spend double the amount necessary and not get your required protection. On the other hand, the lowest bid can be the costliest.

Mundet has a closely integrated, experienced, nation-wide organization. Our engineers will survey your plant to see that the necessary lines and equipment are insulated with the *right material* and the *right thickness* to provide greatest economy and longest life.

The value of Mundet service can be easily demonstrated. The quality of Mundet insulating products is guaranteed. Mundet Products cover every temperature requirement from minus 200°F. to plus 1900°F. One of our newest products is WATER RESISTANT 85% magnesia designed to protect hot piping and equipment from water exposure damage. Send coupon for information on this and other Mundet products.

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LOS ANGELES, CAL. (Maywood) 6116 Walker Ave.
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7103 Tonnelle Ave., North Bergen, N. J.

Send information on Mundet Industrial Insulations.

NAME .....

FIRM .....

ADDRESS .....

What's Happening. . .

a time-losing injury despite numerous potential laboratory hazards.

General Petroleum Names Pollution Control Head

Gerald Fisher has been appointed pollution control coordinator for the General Petroleum Corporation.

Fisher

A veteran of over 30 years with General Petroleum, Fisher has been manager of the Lubricants and Process Products department since 1944. He is a native of Scotsburg, Ind., and a graduate of the University of Oklahoma. He is a member of the ACS, the Army Ordnance Association, the SAE, Alpha Chi Sigma, honorary chemical fraternity.

Tide Water Makes Gleason New Manufacturing Aide

Laurance A. Gleason has been promoted to assistant to the vice president in charge of manufacturing in Tide Water Associated Oil Company's Eastern division.

Gleason

Gleason joined Tide Water Associated in June, 1947, as a junior engineer in the Process Control department at the company's Bayonne, N. J., refinery. He was promoted to technical assistant in the same department in November, 1951, and the following month was named technical assistant to the general superintendent at the refinery, his most recent position.

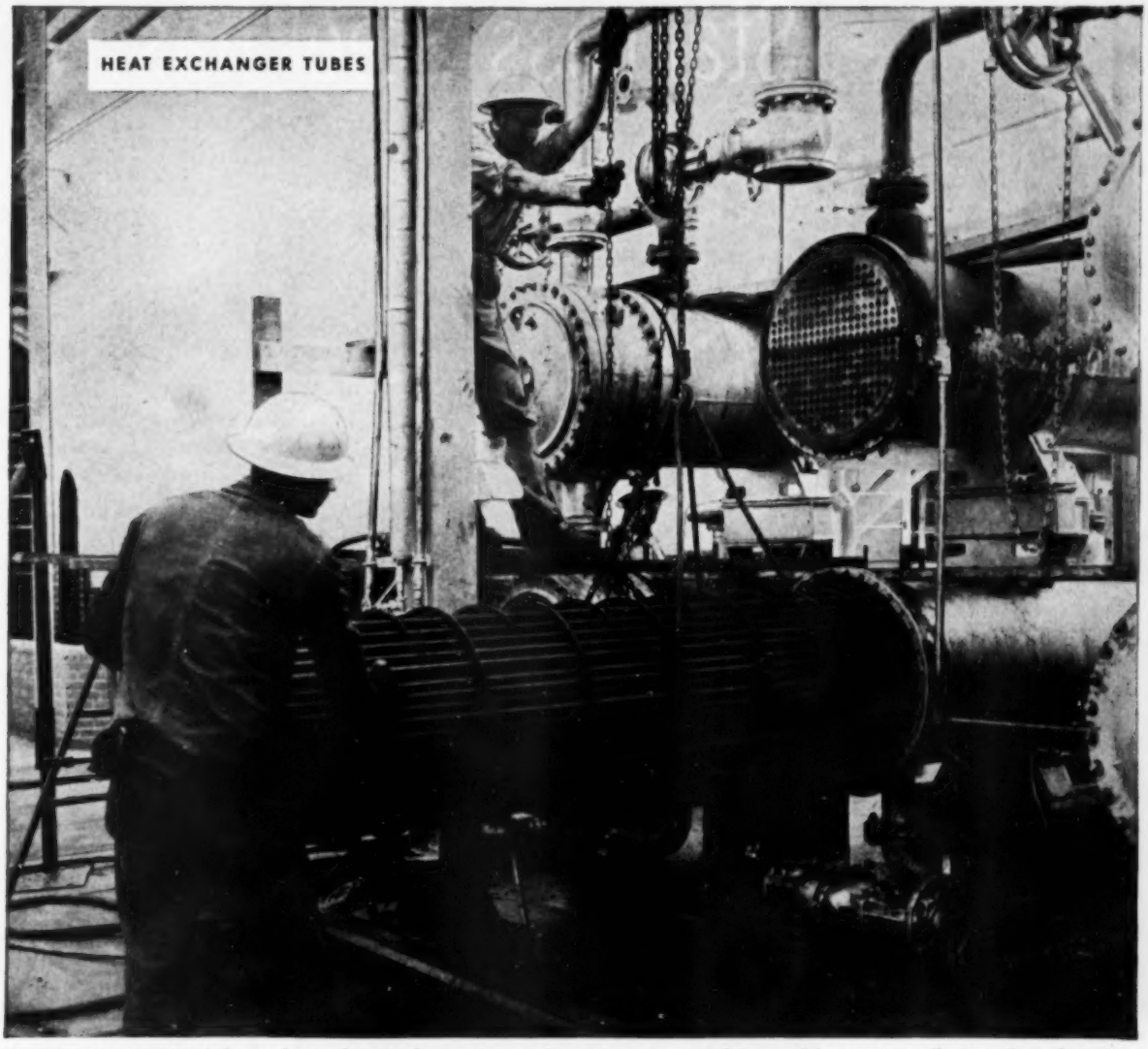
Pure Oil Gets Facilities Of Globe Oil and Refining

The Pure Oil Company has acquired all of the refining facilities of the Globe Oil and Refining Company refinery at Lemont, Ill. The Lemont refinery has a daily refining capacity of 47,000 barrels. Operation of the plant by Pure will begin this month. No changes in the installation's operating staff are contemplated.

Exposition Organizer Dies

Charles Ferdinand Roth, president of International Exposition Company, died recently as a result of an automobile accident. He was 68.

Roth was also manager of the National Exposition of Power and Mechanical Engineering (Power Show), International Heating and Ventilating Exposition, and Exposition of Chemical Industries. In a career of 40 years he



PERFORMANCE RECORD of these tubes under actual operating conditions is now a part of Anaconda's extensive collection of case histories.

Use of Anaconda Cupro Nickel, 10%-755 Tubes in Texas refinery may answer your tube problem

Imagine a collection of tube performance case histories that can answer many of the corrosion problems you face!

Our files bulge with such a collection. Here is experience accumulated over almost a century. Here are detailed records of tube performance under hundreds of actual operating conditions.

We can put the information in these files to work for you at once—to help you select the one best alloy for your job.

Here's a case history we are now adding—the use of ANACONDA Cupro Nickel, 10%-755* Tubes in the Port Neches Refinery of a major oil producer.

These tubes—in use two years—cool heavy gas oil in an Alco Exchanger on a Crude Pipe Still Unit. Gas oil at about 500°F.—mildly corrosive—comes in contact with the outside of these tubes. Brackish river water—with a high salt content—circulates through the tubes. Yet the tubes show no sign of corrosion.

CUPRO NICKEL, 10%-755 resists corrosion almost as well as Cupro Nickel, 30%-702; yet it costs much less. Polluted sea water and sea water with entrained air—even at relatively high velocity—have little effect on this alloy.

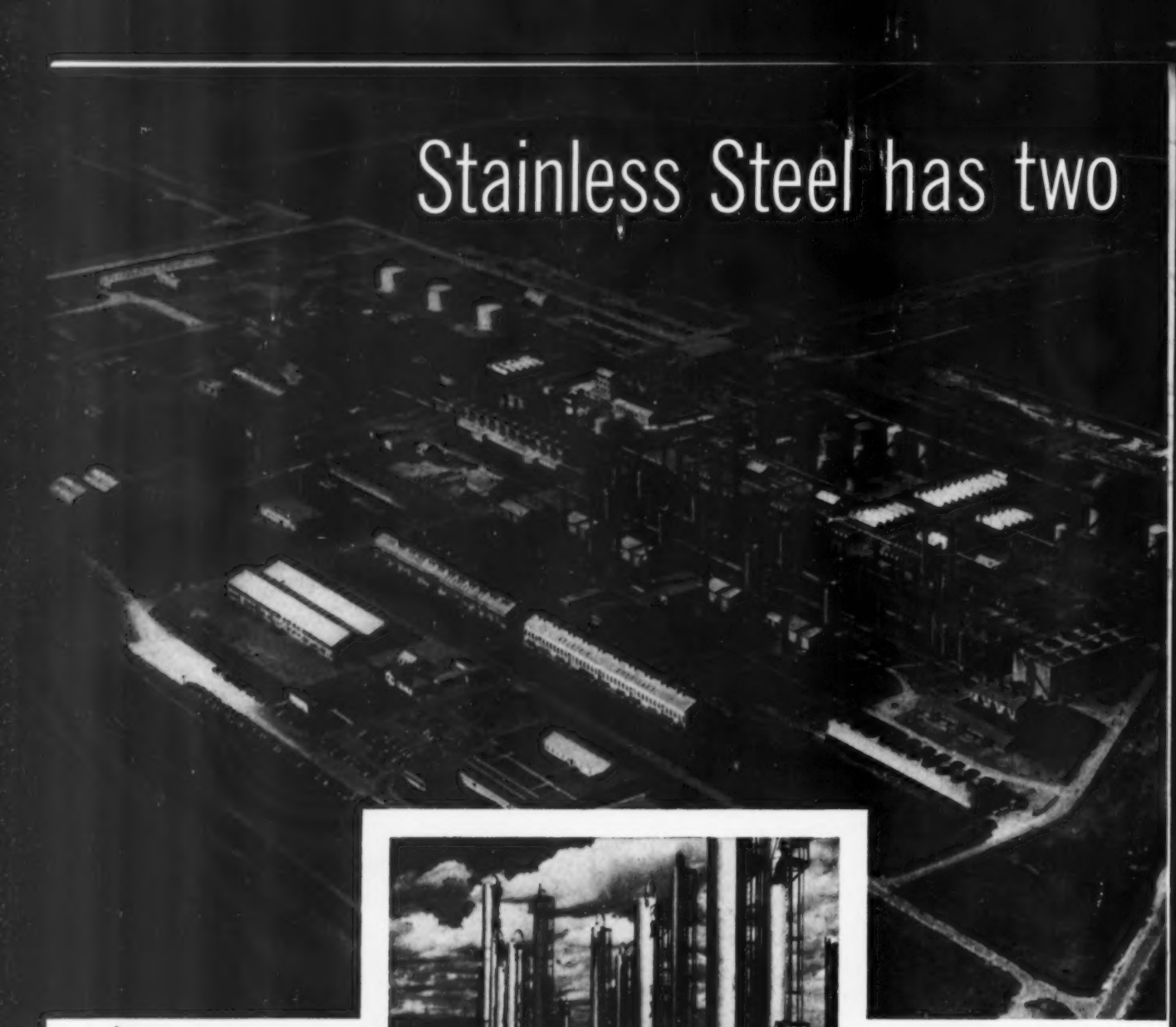
Help for your tube problem. No one tube alloy serves best under all conditions. Your problem is one of choosing the right alloy for the job. Let Anaconda's Technical Department help you. Write, outlining your operating conditions, to Dept. TD, *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

*U. S. Patent No. 2,074,004 54109

ANACONDA®
Tubes and Plates
for Condensers and Heat Exchangers

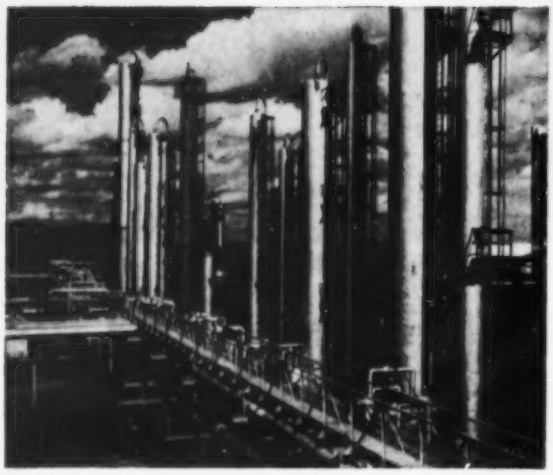
For more data on advertised products, use Readers' Service Cards, last page.

Stainless Steel has two



▲ Aerial view of Celanese Corporation of America's Chemcel Plant at Bishop, Texas.

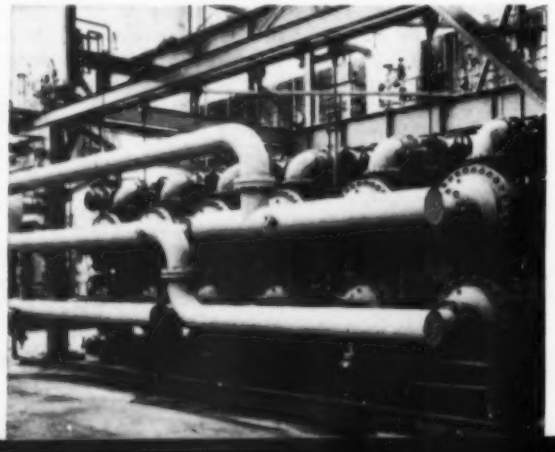
▼ Fractionation tower in the oxidation area is Stainless Steel as are its internals.

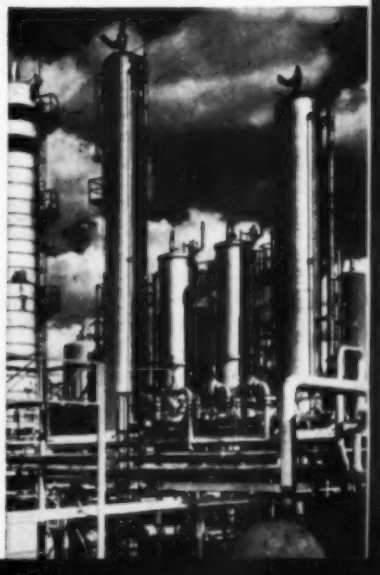


◀ In the acetic acid unit, most towers, tower internals and heat exchangers are Stainless Steel.

▼ Formaldehyde unit at the Chemce Plant, with towers and internals of Stainless Steel.

▼ Heat exchangers, heads and pipes in oxidation area, also Stainless Steel.





big jobs in this plant

. . . RESISTING CORROSION'S ATTACK

. . . PROTECTING PRODUCT PURITY

THIS is the Chemcel Plant of Celanese Corporation of America at Bishop, Texas. Like so many other plants of its nature, it depends heavily on Stainless Steel to keep its operations continually on stream.

The fractionation tower and its internals, located in the oxidation area, are made of Stainless Steel. So are the heat exchangers, heads and pipes in this same reaction area.

Similar applications of Stainless Steel are located in the secondary oxidation or acetic acid unit and in the formaldehyde unit.

In each case, Stainless Steel is doing a dual job. It is used to withstand the attack of the highly corrosive products being handled, and it safeguards the purity of the chemicals being processed.

Along with these primary advantages of Stainless Steel in petrochemical processing go lower maintenance and replacement costs due to Stainless Steel's durability and long life. It will pay you to put Stainless Steel's benefits to work for you, and when you do be sure it is perfected service-tested USS Stainless Steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · NATIONAL TUBE DIVISION, PITTSBURGH
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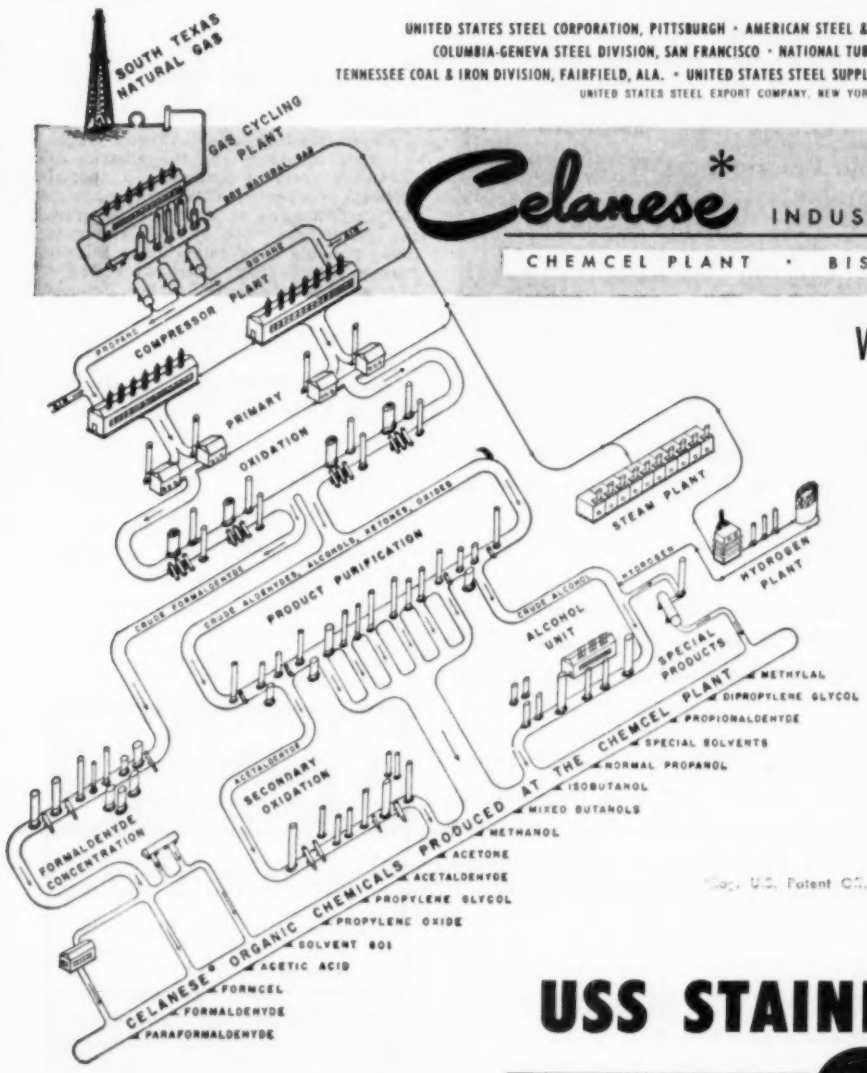
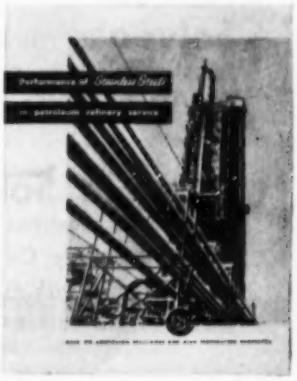


Celanese* INDUSTRIAL CHEMICALS

CHEMCEL PLANT · BISHOP, TEXAS

WRITE FOR THIS BOOK

For valuable data on corrosion resistance and high temperature properties of the many grades of USS Stainless Steel, send for our book "Performance of Stainless Steels in Petroleum Refinery Service." Write to United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.



*Reg. U.S. Patent Off.

USS STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS — USS — PIPE · TUBES · WIRE · SPECIAL SECTIONS

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UNITED STATES STEEL

What's Happening. . .

organized and managed more than 60 industrial expositions.

Sinclair Chemicals Makes Two Personnel Changes

In personnel changes at Sinclair Chemicals, Inc., T. H. Paulsen has become chief process engineer and Robert C. Sweeney assistant manager of market development.

Paulsen was formerly assistant to the vice president in charge of manufacturing and cost estimation. Sweeney was formerly market analyst of the Market Development department.

Tide Water Advances Two To Senior Vice Presidents

Lloyd F. Bayer and Fero Williams have been appointed senior vice presidents of Tide Water Associated Oil Company. They will assist the president in the guidance, direction, coordination and control of the operations, business and financial activities of the company.

Bayer has been with Tide Water since October, 1916, and for several years past has served as vice president in charge of the company's Western division. He is also a member of the board of directors.

Williams was elected to Tide Water's board of directors in 1952 and in May, 1953, became vice president-controller.

Sinclair Promotes Arner to New Manufacturing Post

R. G. (Dick) Arner, manager of Sinclair Refining Company's East Chicago, Ind., refinery, has been promoted to the newly created position of assistant to the vice president in charge of manufacturing.

Arner

A veteran of 35 years in the Sinclair organization, Arner will coordinate refinery department relations with crude oil purchasing, pipe line transportation, research and marketing operations, particularly in respect to refineries at East Chicago, Wood River, Ill., and Sinclair, Wyo. He will also undertake special assignments relating to refinery department problems.

His headquarters will be in the Sinclair Oil Building now nearing completion in Chicago.

Westinghouse Awards 32 Science Fellowships

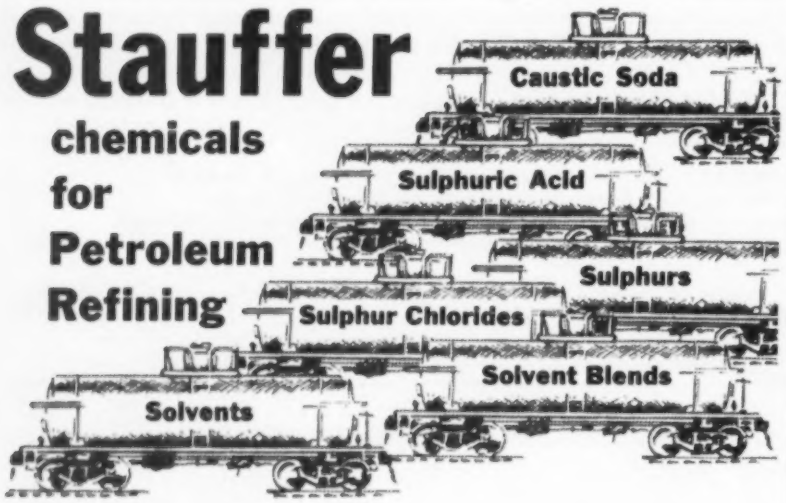
Thirty-two high school science teachers from 20 states and the District of Columbia are now attending a special six-week course in chemistry, physics and mathematics at Carnegie Institute of Technology. The special session is made possible by Westinghouse Educational Foundation, which awarded a Westinghouse Science Teacher Fellowship of $250 to each of the 32 teachers selected by Carnegie Tech.

Brea Chemicals Tops in West Dry Ice Production

With the recent loading of the first shipment of dry ice from its new Carbon dioxide plant at Brea, Calif., Brea Chemicals, Inc., subsidiary of Union Oil Company of California, has become the largest producer of dry ice in the West. Combined production from company plants at Brea and Santa Maria will be 150 tons a day.

Brea Chemicals erected the new carbon dioxide unit as an adjunct to its recently completed multimillion dollar ammonia plant at Brea.

Stauffer
chemicals for Petroleum Refining



Basic Chemicals . . . Caustic Soda, Sulphuric Acid, Processed Sulphurs, Sulphur Chlorides are a few of the basic materials Stauffer supplies the petroleum industry.

Solvents . . . Carbon Disulphide, Carbon Tetrachloride, and Perchlorethylene are produced at 10 of the 38 Stauffer plants. These solvents are available in drum to tank car quantities—coast to coast.

'Custom' Solvent Blends . . . Stauffer can also supply bulk quantities of blended solvents, needed by many refiners. Carbon Disulphide, Carbon Tetrachloride, or Perchlorethylene, in blends or in mixtures with other solvents, are available in drum or tank car quantities. Contact a Stauffer office for more detailed information.

Stauffer Chemical Company
SINCE 1885

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380 Madison Avenue, New York 17, N. Y.
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CONCRETE
SAND AND CEMENT
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We have the equipment, personnel and experience to complete any and all GUNITE work regardless of size or location.

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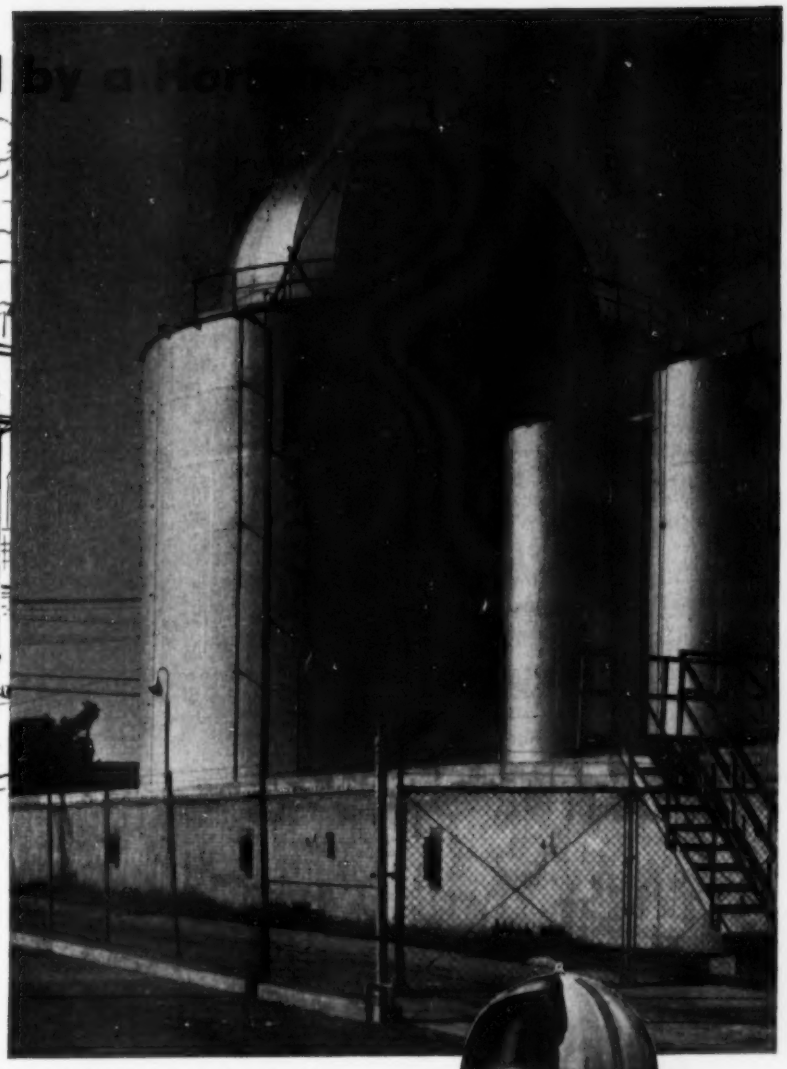
Vapor saved by a Hortondome Roof . . .

. . . is like money in the bank

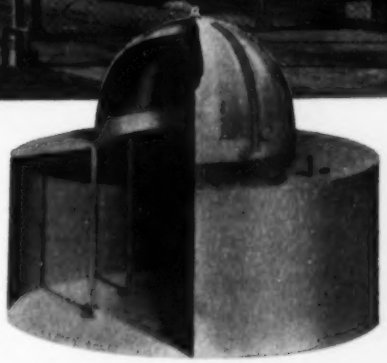


Above: 15,000-bbl., 48-ft. diam. by 48-ft. high, flat-bottom tank with 20,000-cu. ft. Hortondome Roof built for the Shell Oil Company at Los Angeles.

Volatile hydrocarbons stored in fixed roof tanks are subject to large evaporation losses. And each and every cubic foot of vapor vented to the atmosphere costs you money!

Solution to the problem is a Hortondome* Roof. Vapor from the tank upon which the Hortondome Roof is installed, and also from interconnected tanks, is stored under the flexible hemispherical membrane in the dome. When conditions causing displacement are reversed, the vapor returns to the tanks . . . and you can bank the money saved!

Further information, estimates or quotations on Hortondome Roofs may be obtained by writing our nearest office.



Above: Cutaway view showing the construction of the Hortondome Roof.

*Trade Mark

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

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Birmingham 1	1548 North Fiftieth Street	Houston 2	2126 C & I Life Building	Salt Lake City 4	531 West 17th South Street
Boston 10	1030—201 Devonshire Street	Los Angeles 17	1534 General Petroleum Building	San Francisco 4	1551—200 Bush Street
Chicago 4	2463 McCormick Building	New York 6	3302—165 Broadway Building	Seattle 1	1331 Henry Building
Cleveland 15	2234 Midland Building	Philadelphia 3	1608—1700 Walnut Street Building	Tulsa 3	1626 Hunt Building

REPRESENTATIVES AND LICENSEES

Ateliers et Chantiers de la Seine Maritime, Paris, France
Compagnia Tecnica Industrie Petroli, Rome, Italy
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Chicago Bridge & Iron Company, Ltd., Apartado 1348, Caracas, Venezuela
Sociedade Chibridge de Construcoes Ltda., Av. General Justo 275, Grupo 306, Rio de Janeiro, Brazil
Horton Steel Works Limited, Fort Erie, Ontario, Canada
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Whessoe, Limited, Darlington, England
Comprimo N. V., 21, Amstel, Amsterdam (C) Netherlands

For more data on advertised products, use Readers' Service Cards, last page.

What Suppliers Are Doing . . .

Russell Rock Connor Davis Klee McMahan Farrell Young Jaeger

C. E. Russell, who has been manager of the Machining division, has been promoted to assistant works manager of **The J. B. Beaird Company,** Shreveport, La.

William A. Rock, who has been with **The Foxboro Company** since 1945, and most recently managed its Corpus Christi, Texas, office, has joined Shultz y Cia., S. A., of Mexico City, Foxboro's representative in Mexico. He will headquarter in Monterrey.

N. J. Connor has become manager of the New York district office of **The Babcock & Wilcox Company,** replacing H. E. Martin, resigned. He had been assistant manager of the office since 1946.

William A. Davis, Jr., has been named Southeastern representative for the Engineering, Manufacturing and Construction divisions of **Vulcan Copper & Supply Company,** Cincinnati, Ohio. He will headquarter at Charlotte, N. C., where he has been since 1947, employed as an engineer with R. H. Bouligny, Inc., and as a manufacturer's agent.

Harold J. Klee, formerly manager of the Chicago sales district, has been appointed manager of the newly organized Central Sales division of **Stauffer Chemical Company.** He has been replaced at Chicago by J. H. Begley, formerly assistant manager.

William A. McMahan has been made Western district sales manager for **Carver Pump Company,** Muscatine, Iowa. He will cover Arizona, California, Oregon, Washington, Nevada, Utah, Idaho, Wyoming and Montana. He was previously associated with Carver Pump before leaving to serve in the U. S. Navy. He recently returned to Muscatine for a few months.

E. L. Farrell has been appointed district manager for the Milwaukee territory and **Wm. C. Young** district manager of the Great Lakes territory of the Heavy Machinery division of **Nordberg Manufacturing Company.** The Milwaukee territory includes Wisconsin, Minnesota, Iowa and northern Illinois. The Great Lakes territory serves Michigan, Indiana, Ohio, western Pennsylvania and eastern Kentucky. Farrell was formerly a sales engineer in Nordberg's Milwaukee office, while Young held a similar post in the firm's Washington, D. C., office.

Martin B. Jaeger has been promoted from assistant publicity manager to publicity manager of **Bucyrus-Erie Company,** South Milwaukee, Wis., succeeding Emory M. Heuston, resigned.

Walter P. Hooper, formerly of Buffalo, N. Y., has been appointed administrative vice president of **Panellit, Inc.,** and its two divisions, Panalarm and Panascan.

Ralph H. Soape, Orbit Valve Company representative at Corpus Christi, Texas, for the past three years, has been transferred to the company's Houston branch office. **Howard M. Johnson** replaces him as Southwest Texas representative for Orbit and will headquarter at Corpus Christi. Johnson formerly represented Rector Well Equipment Company.

Redgnald D. Bushell, formerly account representative in the Eastern region, has become New York district manager of **Ethyl Corporation.**

Lavelle E. "Bu[illegible]" Jones has been appointed Casper, Wyo., district sales manager of **Black, Sivalls & Bryson, Inc.** Jones has been with BS&B 16 years and prior to his appointment was assistant district manager at Alice, Texas. He is replaced in that position by **Harrell Bruner,** who has been transferred from Salem, Ill., where he was formerly a salesman.

W. T. Ireland has been named sales representative for **Wolverine Tube** Division of Calumet & Hecla, Inc. He was formerly with Bundy Tube Company.

Fenmore E. Dunn has been chosen general manager of **Worthington Corporation's** reorganized Vertical Turbine Pump division. Dunn has been with Worthington since 1950 and has an extensive background in the development and sale of vertical turbine pumps.

C. G. Bragg has been named resident manager of the newly opened Calgary, Alta., office of **The Fluor Corporation of Canada, Ltd.,** Toronto, Ont. The office will be in the Oil Exchange Building. Bragg has been a process engineer with Fluor for the past eight years. P. D. Mellon, special representative in Calgary who has represented Fluor in the past, will continue to act in an advisory capacity. J. T. Sparling, of Sparling Sales, Ltd., Edmonton, will represent Fluor in that area.

Davison Opens New Office In Houston, Transfers Two

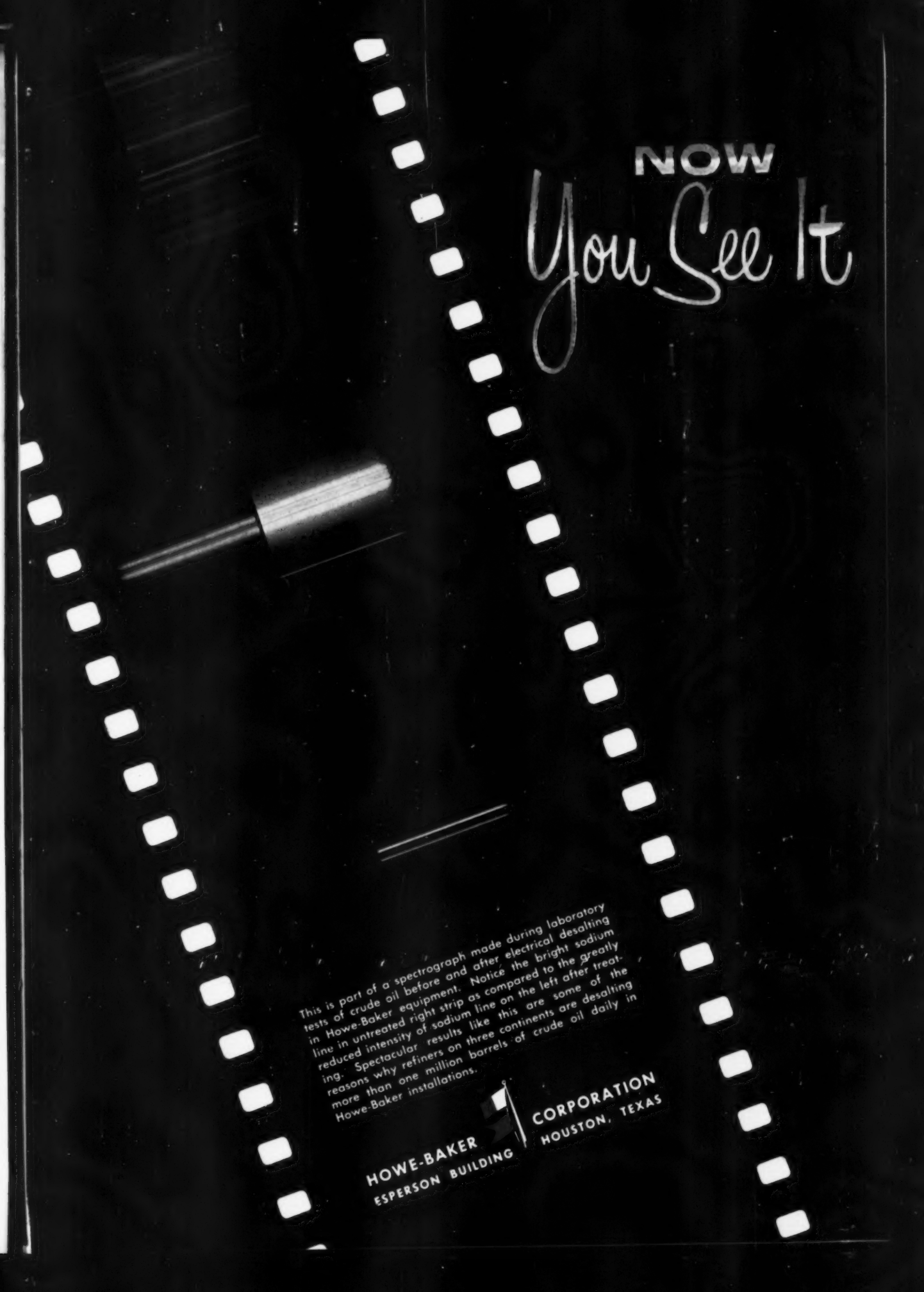
A new sales office has been opened in Houston by Davison Chemical Company Division of W. R. Grace & Company to cover the Southwest and Gulf Coast areas.

John Benedict, sales representative of the Petroleum Catalyst department, has been transferred to Houston from Baltimore to promote Davison's fluid cracking catalysts and other products of interest to petroleum refiners. C. Victor Bolles, field service engineer, has been moved to Houston from Lake Charles, La., to handle sales of silica gels, fine silicas, specialty catalysts and other products.

North American Philips Opens Division Office at Houston

A new Houston office has been opened by the Research and Control Instruments division of North American Phil-

Hooper Soape Johnson Bushell Jones Bruner Ireland Dunn Bragg


NOW
You See It
This is part of a spectrograph made during laboratory tests of crude oil before and after electrical desalting in Howe-Baker equipment. Notice the bright sodium line in untreated right strip as compared to the greatly reduced intensity of sodium line on the left after treating. Spectacular results like this are some of the reasons why refiners on three continents are desalting more than one million barrels of crude oil daily in Howe-Baker installations.
HOWE-BAKER CORPORATION
ESPERSON BUILDING HOUSTON, TEXAS

In today's high production pattern, when one unit can be made big enough to do the work of two or more smaller units substantial economies result... economies in connecting pipe systems, in duplicate controls and instrumentation, in operating man power.

Don't let equipment manufacturing capacity be a limiting factor

Take it up with Stearns-Roger

Here's an example of the ability of Stearns-Roger to turn out the "big ones":

Still designed and built by Stearns-Roger in its Denver shops for a natural gasoline plant owned by Southern Production Company and Humble Oil & Refining Company in the Pledger Field, 70 miles south of Houston.

One of the largest in the industry, this unit is 12 feet 10 inches in diameter and 124 feet long. It is built of special quality 5/8" steel plate, weight 205,000 pounds.

Shipment on three flatcars was scheduled for daytime travel only at maximum speed of 25 miles per hour, over special routing to obtain sufficient clearance. On sharpest curve enroute, center of Still swung 17 feet away from center axis of middle car.

ENGINEERING
DESIGNING
MANUFACTURE
CONSTRUCTION

Stearns-Roger

THE STEARNS-ROGER MFG. CO. DENVER, COLORADO

DENVER · HOUSTON · SALT LAKE CITY · EL PASO

ips Company, Inc. It will serve Texas, Mississippi and Louisiana and will be managed by Robert Seibert.

Bonney Has Personnel Changes

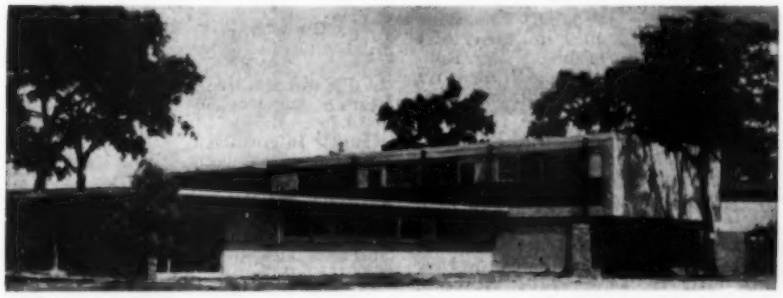
Organizational changes of personnel at Bonney Forge & Tool Works, Allentown, Pa., have been announced. Bonney Forge & Tool Works is a subsidiary of Miller Manufacturing Company.

Spencer H. Mieras and Kenneth Foust, both with the Miller organization in Detroit, have been appointed general manager and secretary-treasurer, respectively. The changes resulted from the recent resignation of Arthur J. Male, chairman of the board; Fred S. Durham, Jr., vice president and secretary, and Edward S. Howells, treasurer.

Three Receive Appointments In Changes at Allis-Chalmers

Three organizational changes at the Norwood Works of Allis-Chalmers Manufacturing Company have been announced.

Thomas C. Knudsen, formerly manager of the Texrope Drive section, has been appointed assistant to the general manager in charge of the mechanical product development laboratory. Vernon B. Honsinger, formerly engineer-in-charge, research laboratory, has been named assistant to the general manager in charge of the electrical product development laboratory. Dwight H. Lory, formerly assistant manager of the Texrope Drive section was appointed manager of that section.



Texas Pipe Bending Moves—

While recently consolidating its Plants No. 1 and No. 2 at the intersection of Old Galveston Highway and the La Porte Expressway in Houston, Texas Pipe Bending Company moved into this new office building at the same location. Having a floor area of 9000 square feet, the new and larger quarters consist of two executives offices, a conference room, drafting room, coffee bar and numerous other offices.

Suppliers . . .

Stauffer Promotes Gunder to Manager of Western Sales

The Industrial Chemicals division of Stauffer Chemical Company has announced the promotion of Roger W. Gunder to western sales manager of the company.

Gunder

Gunder, who for the past 20 years has served with Stauffer, was formerly manager of the company's Los Angeles sales district. With his new appointment, which is effective immediately, he will move his office from Los Angeles to the Stauffer San Francisco office.

Hooker Makes Key Changes

Several important organizational changes have been made by Hooker Electrochemical Company, as follows: Hiram B. Young, formerly works manager of the Niagara Falls, N. Y., Ashtabula, Ohio and Montague, Mich., plants, has been elected vice president in charge of eastern production. Thomas E. Moffitt, formerly western manager of the company's Tacoma, Wash., plant and other west coast activities, has been elected vice president in charge of western operations. F. Leonard Bryant, formerly superintendent of the Niagara

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No matter what your liquid hauling problem, we can help you. Each tank trailer manufactured is designed specifically for a particular job. Each is engineered for the product . . . for the truck . . . for individual state highway and ICC requirements . . . and each is designed to provide a maximum pay load.

Whether you plan to haul liquefied petroleum gases, casein head gasolines, caustics, acids, anhydrous ammonia, mercury decapitan, or other liquids, we have the tank to fit your need. And what's more we have it at a price which will appeal to to you. The LMC budget plan will enable you to buy on convenient terms. Write for more information on prices and payloads.

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LOW MILEAGE COST

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For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

plant of the company, has been named works manager of this plant.

Craig Transferred to Head Stoneware Houston Office

U. S. Stoneware Company, Akron, Ohio, has opened a direct factory sales office in Houston to broaden its range of service to the Southwest.

Craig

Stanley Craig, for several years assistant sales manager for U. S. Stoneware in its home office at Akron, will be in charge of the new offices in Houston. Craig has had a broad background of experience in solution of corrosion problems.

Craig will make his headquarters at 7621 Brykerwoods Drive in Houston.

Air Products Sets Up New Research Fellowship at Rice

Air Products Inc. of Allentown, Pa., has established a research fellowship at Rice Institute for thermodynamic studies at low temperatures. The work is to be under the direction of Dr. W. W. Akers of the Chemical Engineering Department at Rice.

Evans Heads Key Changes in Diamond Alkali Management

In promotions in Diamond Alkali Company's management organization, William H. Evans has been appointed vice president. During the last six years, he has been manager of silicate operations.

Other advancements:

John W. Mantz, assistant general manager of Diamond's Painesville plant since 1950, to general manager of the newly created Silicate, Detergent, Calcium division.

L. T. Welshans, for the past seven years technical director of the Painesville plant technical staff, to general manager of the newly created Cement and Coke division.

C. R. Brown, manager of industrial relations at the Diamond Painesville plant since April, 1950, to assistant works manager, succeeding Mantz. Robert McConnell, who has been Brown's assistant, becomes manager of industrial relations at Painesville.

Schindler New Hercules Head Of Explosives Export Sales

J. Henry Schindler, Jr., has been named manager of export sales of explosives at Hercules Powder Company, with headquarters in the company's New York office. He succeeds J. R. St. Clair, recently retired after 35 years with Hercules.

In the past few years, Schindler has done technical service work on the use of industrial explosives in Hawaii, the Philippines, Mexico, Puerto Rico and Nicaragua.

Kellogg Subsidiaries Elect Three New Vice Presidents

Three vice presidents have been elected by subsidiaries of The M. W. Kellogg Company.

Champlin Carnesale

James A. Petrie, Jr., for the past three years manager of the London office of Kellogg International Corporation, has been elected a vice president and reelected a director of the firm. Frank E. Johnson succeeds him in the London office.

Petrie

Donald W. Champlin, vice president of The M. W. Kellogg Company, has been elected a vice president of The Canadian Kellogg Company, Ltd. M. Joseph Carnesale has also been elected a vice president at Canadian Kellogg.

BS&B Announces Series of Changes in Field Personnel

The following personnel changes have been announced by Black, Sivalls & Bryson, Inc.:

Sam Worrall has been appointed manager of the Salem, Ill., branch. He had been sub-branch manager and sales representative at Carmi, Ill.

Frank Black, who has worked in the company's Houston area since joining it January, 1947, has been assigned as branch manager of the Houston office.

Jimmy Crume, field salesman in the Salem branch, has been transferred to Carmi as sub-branch manager.

Alvin Teal, former group leader and product development engineer in the Oilfield Engineering department, has become district engineer at Alice, Texas.

Bud Bricmont has been transferred from the Oklahoma City district, where he was field engineer, to Shreveport, La., as district engineer.

John Humphrey has been transferred from Drumright, Okla., where he served as field salesman, to Borger, Texas, as sales and service representative.

Jack Records has been named field salesman, working out of Ardmore in the Oklahoma City district. He was formerly with Grove Regulator Company.

Wayne Robb, salesman trainee, has been appointed field salesman at Salem.

Carbide and Carbon Promotes Benedict to Works Manager

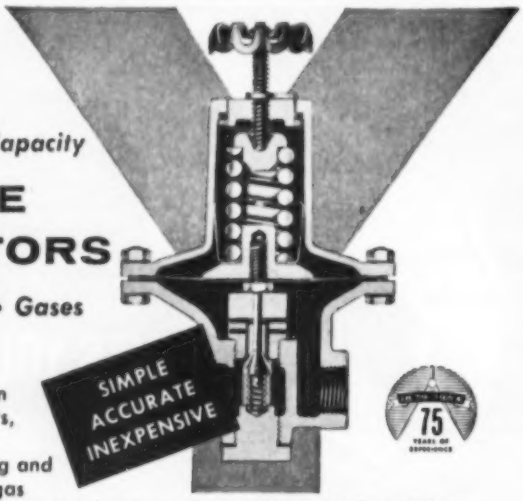
Donald B. Benedict has been appointed works manager of Carbide and Carbon Chemicals Company, a division

FOSTER Y-TYPE

Small Bore — Small Capacity

PRESSURE REGULATORS

for Steam • Liquids • Gases



Thousands of these versatile valves are in service on unit heaters, cookers, and plastic presses; glass blowing and bottling machinery; gas or oil firing; sterilizers and vulcanizers; instrument control, and low pressure heating.

These valves are unusually sensitive to slight variations in reduced pressure, and give close regulation. Yet they are so simply designed that they present no maintenance problems.

They are built for initial pressures as high as 3000 P.S.I. for air and liquids, 300 P.S.I. for steam; for reduced pressures ranging from ounces to 250 P.S.I. Sizes ¼" through ¾" depending on type. Available in stainless steel alloys. Write for Bulletin Y-101.

FOSTER ENGINEERING COMPANY

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AUTOMATIC VALVES • SAFETY VALVES • FLOW TUBES

Suppliers . . .

of Union Carbide and Carbon Corporation. He was formerly assistant works manager in Carbide and Carbon's New York office.

Timken Roller Bearing Ups Three in Organization Shifts

Organization changes at The Timken Roller Bearing Company have resulted in the promotion of Herschel M. Richey,

Richey Young Tobey

factory manager of the Bearing and Rock Bit division, Henry A. Tobey, general superintendent of the Canton, Ohio, Bearing division, and Wilbur L. Young, assistant chief inspector.

Richey will become general factory manager, Tobey factory manager of the Canton and Gambrinus bearing factories, and Young general superintendent of the Canton Bearing division.

General Electric Revamps Meter and Instrument Group

Formation of a Meter department and an Instrument department has been announced by General Electric Company. The move divides the former Meter and Instrument department into two separate units. The Meter department will make its headquarters at Somersworth, N. H., while the Instrument department will remain at Lynn, Mass.

C. Howard Black, formerly general manager of the Meter and Instrument department, has been named general manager of the new Instrument department, while D. E. Craig, previously manager of the Somersworth plant, has been appointed general manager of the new Meter department.

Concurrent with their appointments, the new general managers announced the following staffs for their departments:

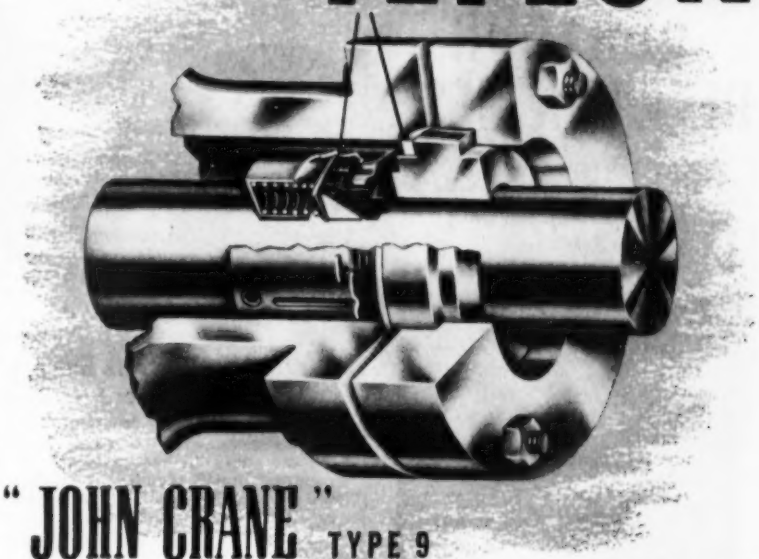
Instrument department—J. C. Garrett, manager-marketing; I. F. Kinnard, manager-engineering; L. P. Hannaway, manager-manufacturing; H. P. Schott, manager-finance; J. H. Dennis, manager-inspection; and N. F. Schlegel, manager-employe and plant community relations.

Meter department—Bruce B. Gravitt, manager-marketing; G. Rodger Sturtevant, manager-engineering; Richard B. Gray, manager-manufacturing; John J. Greeley, manager-finance; and Clifford H. Miller, manager-employe and plant community relations.

Lukens Reassigns Meyer

Harry R. Meyer has been named manager of sales for the By-Products and Lukenweld divisions of Lukens Steel Company, Coatesville, Pa. He served as

NOW—A SHAFT SEAL THAT WITHSTANDS ANY CHEMICAL.....Designed WITH * TEFLON



"JOHN CRANE" TYPE 9 Mechanical Seal

Prevents Leakage of:

- √ EXPENSIVE CHEMICALS
- √ INFLAMMABLE LIQUIDS
- √ TOXIC GASES
- √ CORROSIVE LIQUIDS
- √ SOLVENTS

Other John Crane Teflon Products include expansion joints, C-V Rings, packings and gaskets. Also, parts molded or machined to your particular requirements.

This revolutionary seal was developed by Crane Packing Company after two years research and field testing—expressly for use with hard-to-handle chemicals. Its flexible wedge ring and sealing ring are molded from the remarkable new plastic, Teflon, which is not affected under any known corrosive or solvent service.

John Crane engineers thus put the unique properties of Teflon—high heat resistance, extremely low friction and chemical inertness—to practical use in the Type 9 Seal. Result: a new, efficient way to handle corrosive liquids and gases that never before could be effectively controlled by conventional, flexible-type mechanical seals. It can be employed at temperatures up to 500°F.

The Type 9 Seal gives consistently dependable service on all rotating shaft applications, such as centrifugal pumps, turbines, speed reducers, positive displacement pumps and agitators

Write today for new booklet describing the "John Crane" Type 9 Shaft Seal—
CRANE PACKING COMPANY, 1820 Cuyler Ave., Chicago 13, Illinois

In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

*DuPont's trademark

JOHN CRANE CRANE PACKING COMPANY

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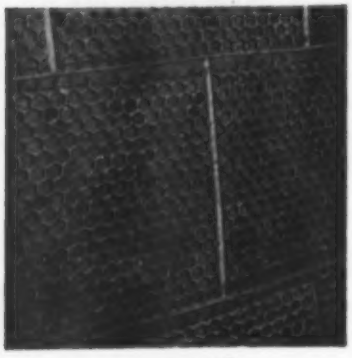
Used with
Castable Ganister Linings
in Refractionating Units
in Petroleum
& Chemical Industries



RIGHT for

★ Thermal Cracking Units
★ Cyclones
★ Fluid Catalytic Regenerators
★ Fluid Catalytic Reactors
★ Hydroformers & Reactors
★ Flue-Gas Stacks & Ducts
★ Catalyst-Carrying Pipe Lines

REDUCE EXPENSIVE SHUTDOWNS
by using
Irving "GRIDSTEEL",
the quality contour retainer mesh.

IRVING SUBWAY GRATING CO., INC.
ESTABLISHED 1902

OFFICES and PLANTS at
5090 27th St., Long Island City 1, N. Y.
1890 10th St., Oakland 20, California

Suppliers . . .

manager of sales at By-Products prior to his recent appointment.

Scovill Elects New Director, Promotes Three Executives

Sherman R. Knapp, president and director of Connecticut Light & Power Company, Berlin, Conn., has been named director of Scovill Manufacturing Company, succeeding the late Lester J. Ross. Executive changes made at the same time move Garvin A. Drew to vice president and George W. Gross to assistant vice president of the A. Schrader's Sons division, and George W. Young to assistant vice president of the Oakville Company division.

Drew, who is also general sales manager of Schrader, has been an assistant vice president of Scovill since 1952. Gross, a director of A. Schrader's Sons, has been works manager of the division since 1949. Young has recently been a member of the superintendent's staff and was traffic manager of the Oakville division.

Boiler Manufacturers Elect Henry Vogt's Heuser President

William P. Heuser, manager of the Boiler division, Henry Vogt Machine Company, was elected president of the American Boiler Manufacturers Association and Affiliate Industries at the organization's 66th annual meeting held recently at Hot Springs, Va. He served as vice president of the association during the 1953-54 term.

Rockwell Appoints Again Valve Plant Chief Engineer

Thomas C. Again has been named chief engineer of Rockwell Manufacturing Company's new valve plant at Sulphur Springs, Texas. He joined Rockwell in 1953 as assistant chief engineer of the company's Nordstrom valve plant at Oakland, Calif.

Ethyl Promotes Shank To Suggestion System Manager

Louis W. Shank, who started with the Sales department of Ethyl Corporation 23 years ago as a field representative, has been promoted to suggestion system manager. He will direct a suggestion system which became effective June 1.

Shank

Shank, who began his career with Ethyl in the former Baltimore division, has filled several executive positions in the Sales department. He has been manager of the Baltimore division, manager of the Tulsa division, and southern regional manager of operations. He was transferred to the New York office in 1950 as assistant to the vice president in charge of sales.

U.S. Steel Division Makes Series of Field Appointments

A number of field appointments have been announced by the Oil Well Supply Division of United States Steel Corporation.

Kelly

Weigers

In the division's Gulf Coast Area, Thomas S. Kelly, formerly field representative at Corpus Christi, Texas, has become manager of "Oilwell's" store there, Floyd D. Weigers, formerly at the Corpus Christi store, has succeeded Kelly, and William R. Preslar, with "Oilwell's" Houston store since 1952, has become field representative in that city.

Coburn

In the Mid-Continent Area, John W. Coburn, formerly manager of the Shreveport, La., store, has been promoted to assistant district manager, Oklahoma district, with headquarters at Oklahoma City, and Kendall E. Woods, formerly district representative at El Dorado, Kan., has become district engineer, machinery and equipment sales at Oklahoma City.

In the Central Midwest Area, James O. Donaldson, formerly city representative at Midland, Texas, has assumed duties as manager of the Odessa, Texas, store.

In the Canadian Area, Thomas M. Harvey, previously assistant district engineer at Edmonton, Alta., Canada, has been promoted to district engineer at Calgary.

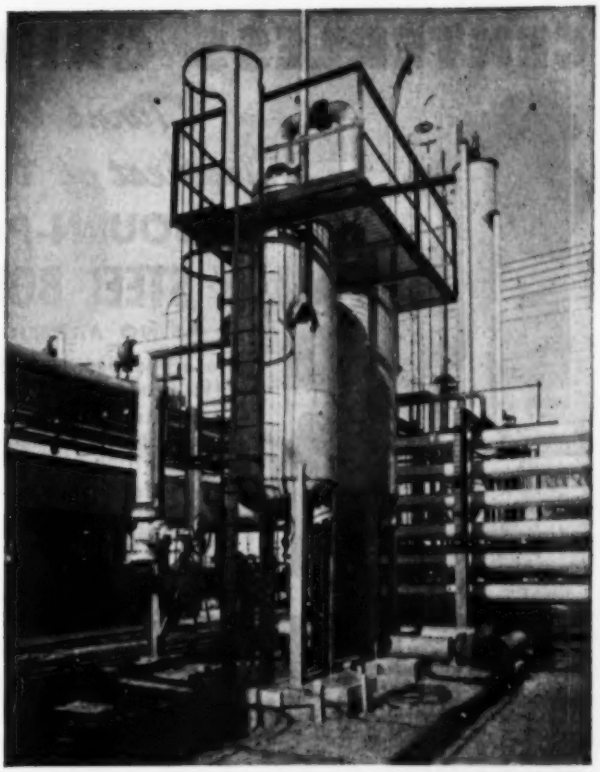
The Oil Well Supply Division also announced the appointment of E. W. Johnson as manager of process pump sales, with headquarters at Dallas, Texas. Prior to his recent appointment he was consultant on centrifugal pumps at Dallas.

Drew Draws New Position in Appointments at Westinghouse

Franklin H. Drew has been appointed to the newly created position of Pacific Coast service manager for Westinghouse Electric Corporation. He will retain his headquarters in San Francisco, where he has been steam superintendent for the region since 1946.

J. N. Jones, Pacific Coast region electrical superintendent since 1949, has been appointed engineering and service manager for the Salt Lake City, Utah, office. He replaces Edward H. Hulse, who has been transferred to East Pitts-

INTERESTED IN UNIFINING* FOR DESULFURIZATION AND UPGRADING



• First Commercial Unifining Unit
United Refining Co.
Warren, Pennsylvania

UNIFINING should be of particular interest to all operators of catalytic reformers which produce by-product hydrogen.

• Harshaw is the exclusive producer of the Union Oil Company of California cobalt-molybdate catalyst used in the recently announced "Unifining" desulfurization and upgrading process. This rugged, commercially proven catalyst is supplied in the form of cylindrical tablets conforming to rigid physical and chemical specifications established by Harshaw and Union Oil Company of California. Stability at high temperatures permits repeated regenerations if and when necessary.

Please contact Harshaw for further information on this catalyst.

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Chicago 32, Illinois • Cincinnati 13, Ohio • Detroit 28, Michigan • Houston 11, Texas
Los Angeles 22, California • New York 17, N. Y. • Philadelphia 48, Pennsylvania
Pittsburgh 22, Pennsylvania

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CENTERLESS GRINDING

Turns Out
Smoothest of **THREADS**
on **KILBOURN-Processed**
ALLOY STEEL BOLT STUDS

AT NO ADDITIONAL COST

- **Made from heat-treated bars — (A.S.T.M. A193 Grade B-7)**
- ***Centerless-ground* for smooth finish — not obtainable with most other production methods.**
- **Far less tendency to seize during assembly or disassembly.**
- **Preferred by refineries, chemical plants, power plants, pipeline installations.**

Write for Bulletin

KILBOURN® *Engineering* Company, Inc.

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STUDS • THREADED BARS • STILL SCREWS • STAINLESS STUDS AND NUTS

Suppliers . . .

burgh, Pa., as mining, petroleum and chemical section manager in the Westinghouse Industry Engineering department.

Heilman Made Traffic Manager In Changes at A. O. Smith

Richard H. Heilman has been appointed general traffic manager of A. O. Smith Corporation to fill the vacancy created by the recent death of Alfred H. Zastrow. Heilman has been traffic manager of A. O. Smith's Milwaukee Works since 1953.

Hendricksen

In other changes at the corporation, Warren Hendricksen has become general sales manager of the Process Equipment division at Milwaukee, a newly created position, and F. A. Gruetjen has been added to the staff of the president with the new title of director of aeronautical development.

Hendricksen had been head of sales for the Pressure Vessel department since 1953. Gruetjen formerly headed the Propeller division and will be succeeded in that capacity by Harris Moyer, who has been with the company since 1947.

H. K. Porter Acquires Pioneer

Pioneer Rubber Mills, Inc., of Pittsburg, Calif., has been acquired by H. K. Porter Company, Inc., Pittsburgh, Pa. Pioneer is the largest manufacturer of industrial rubber products on the Pacific Coast.

Pioneer will become part of Quaker Rubber Corporation, one of H. K. Porter's nine divisions. Sumner M. Suhr, sales manager who has been with Pioneer since 1917, has been appointed manager of the new division under George A. Dauphinais, vice president and general manager of Quaker Rubber.

Koppers Promotes Four

Four promotions have been announced for the Chemical and Gas department, Engineering and Construction division of Koppers Company, Inc.

C. W. Fisher, formerly chief, Project and Technical section, has been named assistant manager of the department to succeed Dr. A. J. Abrams, resigned. Fisher's vacated post will be filled by J. S. Joseph, formerly assistant chief who will be replaced by G. A. Omohundro, process engineering supervisor.

J. M. Airgood, process engineer, has been appointed to succeed Omohundro.

U. S. Rubber Division Gives Delehaunty Additional Duties

Matthew J. Delehaunty has been appointed manager of commodity sales for the Mechanical Goods division, United States Rubber Company. Formerly manager of industrial sales, Delehaunty will combine the functions of both offices in his new post, which was left vacant by the recent death of Harry M. Frecker.

Suppliers . . .

Maise Davies

Wolverine Tube Expands Staff of Aluminum Sales

Rod Davies and Stuart Maise have been appointed sales representatives for the Wolverine Tube division of Calumet & Hecla, Inc. The appointments were the result of expanded facilities in the Wolverine aluminum program.

Davies, formerly plant engineer for Reynolds Metals, will be headquartered in the company's general sales office in Detroit. Maise, a veteran of 20 years in the aluminum field, will be assigned to the firm's East-Central district with headquarters in Detroit.

U.S. Steel Reorganizes and Enlarges Research Personnel

In a further expansion of its research activity, United States Steel Corporation has established new responsibilities and reorganized its technical personnel into three separate but coordinated groups.

To head the activities of these groups, three new assistant vice presidents have been appointed. They are, with their respective fields of responsibility, James B. Austin, fundamental research; Max W. Lightner, applied research and development; and Robert W. Holman, operations research.

Dr. Austin has been head of U. S. Steel's laboratory at Kearny, N. J., and will continue to be located there for the present. Lightner, manager of research and development for U. S. Steel since 1951, will continue in Pittsburgh. Holman moves to Pittsburgh from Gary, Ind., where he has been assistant general superintendent of the Gary Sheet and Tin Mill since 1952.

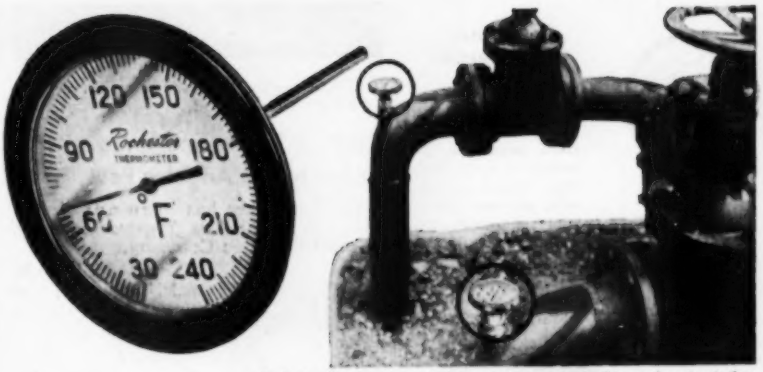
Du Pont Announces Changes In Organic Chemicals Staff

The Du Pont Company has announced establishment of a new Organic Chemicals department sales training section under Emory M. Fanning. William A. Bours III has been assigned as assistant sales director of the "Kinetic" Chemicals division, replacing Fanning.

Francis L. Shackelford, Jr., for the past year assistant sales development manager for the Rubber Chemicals division, has been named chemical sales manager of the Dyes and Chemicals division, replacing Bours.

Lummus Division Renamed

Name of The Lummus Company's piping division has been changed from Western Piping Supply division to Fabricated Piping division. Plant and gen-



Rochester Thermometers give dependable service in this gas booster station.

Where are most of your thermometers?

Most refinery thermometers must be located outdoors, where they're subjected to weather, corrosive fumes, and salt air.

But these conditions are no longer problems with Rochester Thermometers. The all stainless steel welded case is practically immune to all these corrosive agents. Hermetically sealed, pressure-tight dial Rochester Thermometers will give you years of dependable service and *you* can recalibrate them from the outside.

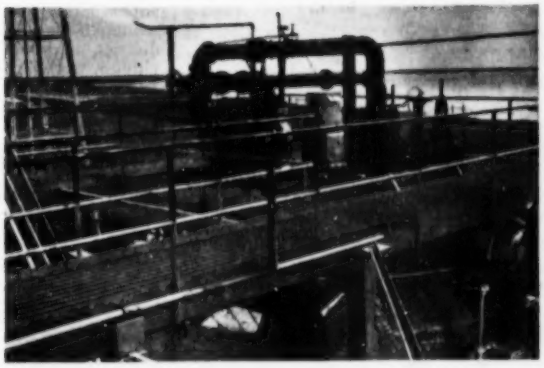
For many installations, you'll be interested in the new Rochester Straight Form Thermometer. It has the same durability and dependability found in all Rochester Thermometers—PLUS a stem that can be mounted anywhere around the dial.

FOR FURTHER INFORMATION, call your Rochester representative, or write:

Rochester Manufacturing Company, Inc.
38 Rockwood St., Rochester 10, N. Y.

DIAL THERMOMETERS GAUGES AMMETERS

WHERE SURE FOOTEDNESS COUNTS



Gary

STEEL GRATING MAKES WALKS SAFER

Sturdy, one-piece construction with tops of all bars flush provides open steel flooring and stairs for safe, easier walking. Gary Grating is furnished in a wide variety of neat appearing designs and sizes—and is tailor-made to fit your needs. For complete description and installation pictures on Gary Welded Grating, Stair Treads and Gary-Irving Decking, ask for Catalog PR-84.

FREE SAMPLE
We'll send this handy paper weight if you request it on your company stationery.

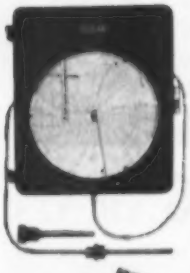
Standard Steel Spring Division
ROCKWELL SPRING AND AXLE CO.
4011 East Seventh Avenue • Gary, Indiana

For more data on advertised products, use Readers' Service Cards, last page.

4½" DIAL THERMOMETERS

Made in 3 types to suit any requirements. Rigid stem, wall or flush mounted, 11 inches of scale reading. Interchangeable with standard industrial separable sockets. Stem can be placed at any angle and case can be rotated to any readable position.

PALMER
MERCURY ACTUATED
Temperature Indicating Instruments



RECORDING THERMOMETERS

Twelve inch die-cast aluminum case with black or white wrinkle or satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges —40 +950°F or Equivalent in °C.

INDUSTRIAL THERMOMETERS

Red-Reading Mercury —Extruded brass case — chrome finish. Ranges —40 + 950°F or Equivalent in °C.

RED-READING MERCURY LABORATORY THERMOMETERS

Thoroughly annealed for permanent accuracy. Complete line A.S.T.M. and fractional division types.

WRITE FOR CATALOG INFORMATION

PALMER
THERMOMETERS, INC.
Cincinnati 12, Ohio • MElrose 1500

Suppliers . . .

eral sales offices of the division remain at East Chicago, Ind.

Central Scientific Moves Baker to Los Angeles Post

Gordon Baker has been appointed manager of the Los Angeles branch of Central Scientific Company.

Baker

He succeeds Richard N. Golbach, who was recently made director of sales.

Baker was formerly manager of the Montreal branch of Central Scientific Company of Canada, Ltd. He joined the company in 1946 as a member of the sales staff. Prior to that he was on the Inspection Board of the United Kingdom and Canada, selecting products for Canadian government use.

Jones & Laughlin Opens New Stores and Appoints Staffs

New stores have been opened by Jones & Laughlin Steel Corporation at Paintsville, Ky., and Worland, Wyo.

H. E. Wagern, district sales manager of the firm's Eastern district, will supervise the Paintsville store, which will be managed by Paul Somerville, formerly at Pineville, W. Va. H. C. Goodwin has been transferred to Paintsville as a salesman.

The Worland store will be under the supervision of M. A. Park, district sales manager of the North Rocky Mountain district, and will be managed by B. J. Gough, transferred from Kermit, Texas. J. R. Robinson, formerly at Longview, Texas, was transferred to Worland as a salesman.

Pakistan Engineering School Gets Turbine in Aid Program

The Electric Power Engineering School of Karachi, Pakistan, has been awarded a turbine generator set manufactured by De Laval Steam Turbine Company, Trenton, N. J. The award was made possible through a grant set up by the Ford Foundation in 1952 to provide basic equipment, technical assistance and training to Pakistani instructors in power engineering. The work is part of an over-all Ford Foundation program to assist Pakistan in the development of its resources.

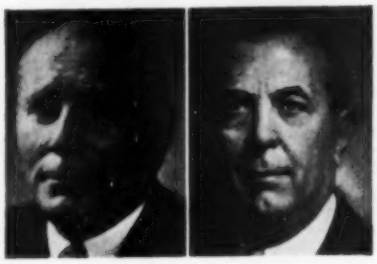
Zvone Succeeds Davis in Post At U.S. Steel Supply Division

Joseph W. Zvone has been appointed vice president—engineering and operations—of United States Steel Supply Division of U. S. Steel Corporation. He succeeds William L. Davis, who is retiring after 48 years of service. Davis joined U. S. Steel in 1905 as a shipping clerk in Donora, Pa.

Zvone joined the Supply Division in 1946 as chief engineer, which position he held until his promotion.

Walworth Elects Belz and Eichler to Top Positions

Fred W. Belz, executive vice president of Walworth Company, has been elected chief executive officer of the



Belz Eichler

company, and chairman of the executive committee.

Alfred J. Eichler, who resigned as president, has been elected chairman of the board of directors.

Belz, who joined the company in 1917, has held various positions within the organization including comptroller, treasurer, and vice president. He has been a director since 1949, and a member of the executive committee of the board of directors since March, 1953.

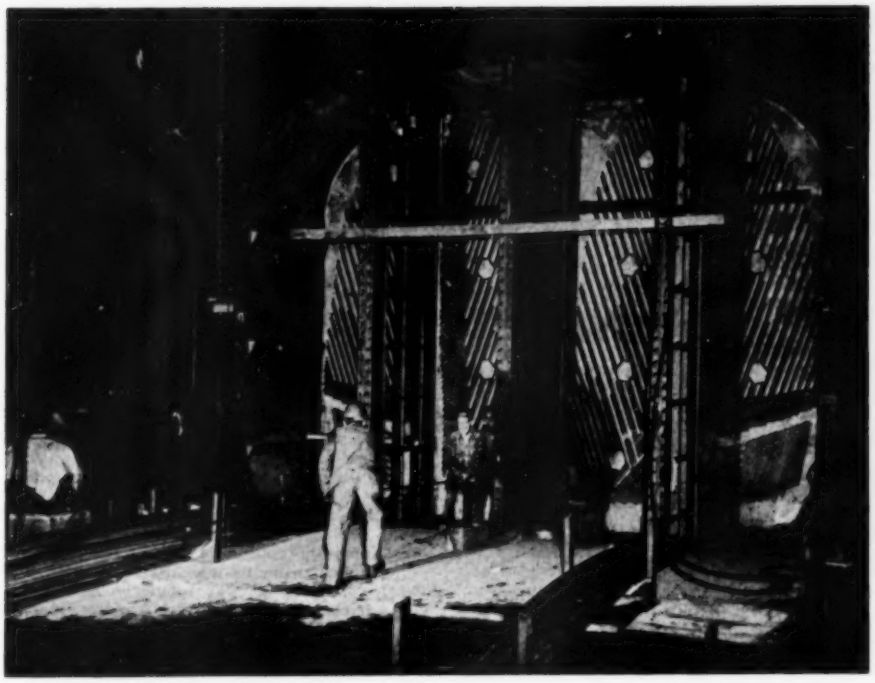
Texas A. & M. Awards Glitsch Professional Degree

A quarter century after he was graduated with a B.S. degree in mechanical engineering from Texas A. & M. College, Hans Carl Glitsch has been awarded a professional degree as mechanical engineer from his alma mater. The presen-

You Can SAVE Power Plant Dollars with

SAND-BANUM
Pure Colloidal Concentrate
OUNCES ONLY ONCE A WEEK
Remove and Prevent Boiler Scale and Corrosion.
More Power – Less Fuel
FEWER SHUT-DOWNS
Stocked by Leading Supply Houses
AMERICAN SAND BANUM CO.
Established 1920
9 Rockefeller Plaza
New York 20, N.Y.

For more data on advertised products, use Readers' Service Cards, last page.



Aluminum Brass Tubes being installed in the world's largest surface condenser. More than 104 miles of tube are being used. As work progresses, platform is gradually raised. (Courtesy Consolidated Edison, New York)

World's Largest Single-Pass Surface Condenser Uses Arsenical Aluminum Brass Tubes

A giant new condenser with a total surface area of 125,000 square feet is being installed at the East River generating station of the Consolidated Edison Company of New York.

It contains 18,360 Arsenical Aluminum Brass Tubes, 7/8 inch O.D., No. 18 BWG, each 30 feet in overall length. Laid out in a straight line, these tubes would extend for 104 miles.

The new condenser is a horizontal, single-shell, single-pass unit with vertically divided water boxes. According to the manufacturer, Worthington Corporation, it is the largest condenser of its type ever built.

Generating Capacity Increase

East River station's net capacity is now 589,000 kw. When Unit No. 7 goes into operation in the Spring of 1955, the net station capacity will be about 762,000 kw. The new turbine combination is rated at 180,000 kw, 3600/3600 rpm. Each generator is rated at 100,000 kva, 0.8 power factor, 3-phase, 60-cycle and 13,800 volts, with ½ lb. hydrogen cooling pressure.

The unit's low-pressure element, comprising two double-flow turbines on a single shaft, will exhaust into the condenser, which is guaranteed to condense 980,000 pounds of steam per hour with a back pressure of 2 inches of mercury absolute when provided with 130,000 gallons of water per minute at 75 degrees Farenheit. Since the average temperature of river water used for condenser cooling is well below 75 degrees, the condenser is expected to maintain a back pressure of less than 1 inch of mercury absolute for most of the year.

Aluminum Brass Tubes

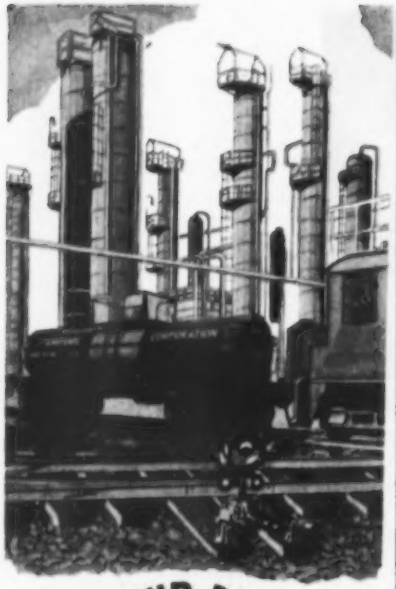
Arsenical Aluminum Brass was selected by Consolidated Edison Company of New York engineers, on the basis of many years of very satisfactory service, as the most economical condenser tube alloy for long, trouble-free life at this station. The alloy selection is particularly important in view of the corrosive nature of the East River water used in the condenser. Although called a river, this body of water is by nature actually a tidal flow with considerable corrosive characteristics because of its salt water, and industrial and urban waste content.

Bridgeport's Arsenical Aluminum Brass Condenser Tubes (Alloy No. 54) are among those used in this huge new condenser unit. Tubes of this alloy are giving excellent service in many other plants at tidewater locations. In these installations, the economy of using Bridgeport Arsenical Aluminum Brass has been proved by long tube life, reduced maintenance, and more efficient operation.

Bridgeport's Technical Service and Corrosion Laboratory are always ready to help you select the most economical Bridgeport Condenser Tube Alloy for your installation. Call your local Bridgeport Sales Office to use these services to your advantage.

BRIDGEPORT BRASS
COMPANY ◆ BRIDGEPORT, CONNECTICUT
Serving Industry with a Nationwide Network of
Conveniently Located Sales Offices and Warehouses
Mills at Bridgeport, Conn., Indianapolis, Ind. and Adrian, Mich.
In Canada: Noranda Copper and Brass Limited, Montreal

For more data on advertised products, use Readers' Service Cards, last page.



SULPHUR-DIOXIDE
HIGHEST QUALITY
SO_2

Side-Track To Successful Operations

Forward-looking industries have found Tennessee's highest quality Sulphur-Dioxide a sure side-track to successful operations. In so many cases, highly efficient and economical operations can be attained through the uses of this chemical (SO_2) with its multi-purposed versatility. We can supply Tennessee's highest quality Sulphur-Dioxide in cylinders, ton drums, tank cars and tank trucks. Let our experienced technicians show you how you might utilize it to your best advantage.

CONTAINERS—
- Cylinders
- Tank Trucks
- Ton Drums
- Tank Cars

Samples, Specifications and Detailed Information on Request.

TENNESSEE TC CORPORATION

617-29 Grant Building, Atlanta, Georgia

Suppliers . . .

tation was made at the school's recent 1954 commencement exercises. Glitsch, president of Fritz W. Glitsch & Sons, Inc., Dallas, Texas, was awarded the degree for his thesis, "Engineering Development of the Glitsch 'Truss-Type' Bubble Tray."

Southwest Industries to Sell Cooper-Bessemer Compressors

Under terms of a contract recently signed by The Cooper-Bessemer Corporation, Mount Vernon, Ohio, and Southwest Industries, Inc., Houston, Southwest Industries will sell Copper-Bessemer skid-mounted or packaged GMXA, V-angle compressors. Southwest will service Texas, Louisiana, Oklahoma, Arkansas and New Mexico.

Cooper-Bessemer will furnish its GMXA compressors to Southwest Industries, which, in turn, will build the skid bases and handle the erection and assembly of all piping and necessary auxiliary equipment to complete the packaged unit.

Fischer & Porter Sets Up New Division Under Stern

A new Data Reduction and Automation division has been established by Fischer & Porter Company. The new division results from Porter's recent acquisition of the patents and engineering personnel of Electrical Development Company, Inc., and Digi-Coder Corporation. Robert K. Stern is the manager of the new division.

BS&B Division Changes Two District Sales Managers

Ralph W. Nichols has been appointed Ft. Worth, Texas, district sales manager for the Oilfield Sales & Service di-

Pool Nichols

vision of Black, Sivalls & Bryson, Inc., and Thomas E. Pool has been named Oklahoma City district sales manager.

Nichols is to head the Ft. Worth offices, at which the Ft. Worth and Abilene, Texas, sales territories were recently combined. He formerly held the position to which Pool was named.

"Ed" Pool was formerly BS&B district sales manager at Abilene. He has been with the firm 15 years.

Kaiser Appoints Carlson

Jack J. Carlson, general sales manager of Kaiser Steel Corporation for the past four years, has been appointed assistant to the vice president and general manager. He has been succeeded in his old post by C. Lee Emerson, formerly Southern district sales manager.

install peak performance into your compressors (AIR · GAS · AMMONIA)

Peak performance, maximum efficiency, greater output, and lower power costs can be built into your oldest, and of course your newest, compressors by the installation of VOSS VALVES.

Check **THESE VOSS VALVE ADVANTAGES:**

✔ Quiet, vibration-free operation ✔ 20 to 60% more valve area ✔ less power consumption ✔ minimum pressure loss ✔ normal discharge temperature ✔ lower operating costs ✔ utmost safety

Our detailed proposal for increasing the efficiency of your compressor will be sent you without obligation. Send us the name, bore, stroke, and speed of your machine.

VOSS VALVES / J. H. H. VOSS Co., Inc. 784 East 144th Street, New York 54, N. Y.

TEMPORARY STRAINERS

MAC-IRON

Established 1901

Made by a skilled mechanic and not by "just some guy with a torch."

REVOLUTIONARY CONSTRUCTION

Smooth, efficient contours . . . no weld "blob" around edge of ring. The flange is precision rabbeted into the ring joint gasket making deformation at that point impossible.

MAC-IRON offers a complete listing of line and temporary strainers. The latter of woven wire, perforated basket and conical . . . all for use with raised face, and ring joint flanges.

A large stock on hand is maintained; special strainers made to specification. Write direct for a catalog and complete information.

The Mack Iron Works Company

Warren and Water Sts. Sandusky, O.

JET-LUBE VL-5 VALVE LUBRICANT

MICRO-GROUND

JET-LUBE VL-5 is a low friction, valve lubricant with micro-ground moly-disulphide. Ends "sticking" valve problems. High temperature. No melting point. Insoluble in hydro-carbon solvents, water, brine, sulphur, acids and alkalies. Batch controlled. Fully guaranteed.

Order through your supply store or send for complete details

JET-LUBE INC.

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Suppliers . . .

Walters Stacy

Rockwell Promotes Two From Houston to New Sales Posts

Jack H. Walters, Houston district sales manager of Rockwell Manufacturing Company's Meter and Valve division since 1951, has been named gas products manager for the entire division. He will make his headquarters at the company's home office in Pittsburgh.

Thomas I. Stacy, a sales engineer in the Houston district since 1940, replaces Walters as district manager.

Company Changes—

Richard F. Graham has been promoted to sales representative for **Hooker Electrochemical Company.** He was formerly with the company's process study group at the Tacoma, Wash., plant . . . **H. Leon Moran** has been appointed to the newly created post of new products manager for the Mechanical Goods division of **United States Rubber Company.** He was formerly factory manager of the division's Fort Wayne plant. **Chester J. Noonan,** vice president of U. S. Rubber, has been appointed to the newly created position of executive manager of the company's Footwear and General Products division and the Mechanical goods division.

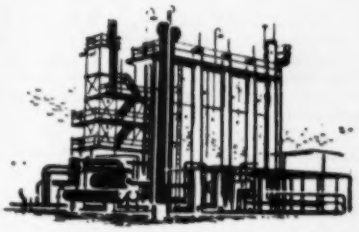
Robert O. Dehlendorf, for the past four years in the Chicago district office of **A. O. Smith Corporation,** has been appointed assistant general manager of the Electric Motor division . . . **R. R. Hogan,** formerly assistant manager, has been appointed manager of the Southern district sales office of **Kaiser Steel Corporation** in Los Angeles. **C. L. Griffith,** who has been in the office since 1945, has been named assistant manager . . . **Jack T. T. Cornwell,** formerly with Hazard Advertising Company, has been appointed advertising and sales promotion manager, Chemical division, **Celanese Corporation of America.** At the same time **Verne Nazarek,** Houston sales representative in the Chemical division, was transferred to New York as assistant to M. W. Kirpalani, export manager of the division.

Ampco Metal, Inc., has appointed **Davis Emergency Equipment Company** of New England, a Class A safety tool distributor . . . **Bailey Meter Company,** Cleveland, Ohio, has moved its Cincinnati district office to larger quarters at 2330 Victory Parkway.

Stuart A. Currie has been appointed manager of the new St. Louis office of **American Cyanamid Company's** Explosives department. He was formerly sales representative for the Pennsylvania

PROBLEM

To produce hydrogen essentially free of carbon monoxide which has a deleterious effect on product quality and plant capacity for edible oil producers.



SOLUTION

GIRDLER developed a highly active durable catalyst, G-12, for removal of carbon monoxide from the hydrogen. Cost of hydrogen production was reduced and carbon monoxide content was cut 95% resulting in:

Hydrogen with less than 5ppm of carbon monoxide

Take advantage of the experience of Girdler in solving *your* catalyst problems!

FOR

Catalysts

WRITE...

The **GIRDLER** *Company*

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

Gas Processes Division

LOUISVILLE 1, KENTUCKY

NEW YORK • TULSA • SAN FRANCISCO

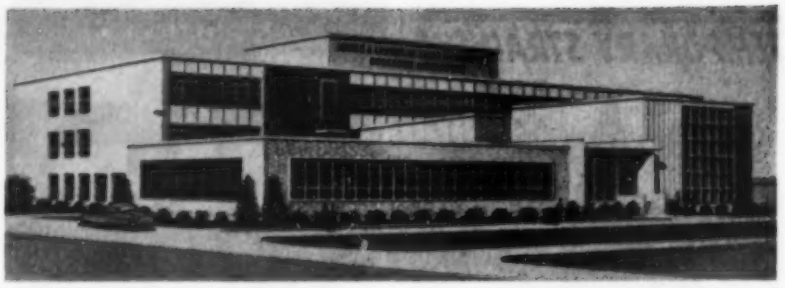
For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

area . . . **Joseph C. Henry, Jr.**, assistant superintendent of the Refractories and Fuel department at **Lukens Steel Company**, has been promoted to superintendent of the department. He succeeds Russell R. Fayles, who is now staff assistant to the manager of fabrication, By-Products division . . . **Edward J. Goett**, formerly with the Charles Pfizer Company, has joined **Atlas Powder Company** as director of the newly created Commercial Development department.

J. E. Taylor has rejoined **The Girdler Company** and has been assigned to the development and application of new catalysts. Dr. Taylor, most recently with Markite Company, was director of research for Girdler's Gas Processes division from 1942 to 1945 . . . **Gene Wedereit**, director of advertising of **The Girdler Company** and **Tube Turns**, divisions of National Cylinder Gas Company, has been reelected chairman of the board of trustees of the National Industrial Advertisers Association's Research Institute.

Jack C. H. Stearns, manager of ingot sales for the Magnesium department of **The Dow Chemical Company** for the past ten years, has been appointed to an executive position with Dow Chemical Export Company, Dow Chemical International Ltd., and Dow Chemical Inter-American Ltd. . . . **George Saum** has been appointed manager of the Taylor Forge Aircraft Products division of **Taylor Forge & Pipe Works. T. E. Marston** has become general sales manager of this division.



J&L Building New Research Center—

Construction has started on Jones & Laughlin Steel Corporation's new research center, artist sketch of which is shown above. Being built on Pittsburgh's South Side, overlooking J&L's Pittsburgh Works, it is to cost initially over $1.5 million and will consist of several buildings when completed in mid-1955.

Two Receive Appointments At Graver Water Conditioning

Leonard Limon has been appointed manager of the Industrial Boiler Feed department of Graver Water Conditioning Company, division of Graver Tank & Mfg. Co., Inc. He has recently been sales engineering manager.

Harold R. Fosnot, assistant general sales manager, has been advanced to sales manager.

Rochester Manufacturing Makes Fribance Chief Engineer

Austin E. Fribance has been appointed chief engineer of Rochester Manufacturing Company. In that capacity he will have charge of product design, and of research and development. He has been with the company since January, 1953.

Foxboro to Open New Factory

The Foxboro Company, Foxboro, Mass., is scheduled to complete its new 15,000-square-foot branch factory being constructed in Pittsburgh this month. Of steel and masonry construction, with modern brick exterior, the new building is being erected on two levels. General offices and sales headquarters will occupy the lower level, while instruments and control valves will be assembled, serviced and stocked in the 12,000-square-foot upper level extension.

De Laval Adds Representatives

Maquinaria Industrial Ltda., Bogota, Colombia, S. A., has been appointed exclusive representative for De Laval Steam Turbine Company products in the Bogota trading area.

Haytian Tractor and Equipment Com-

CONSECO SPECIALTIES.... make your plant run Smoother

Flowrites of various sizes

Air erosion of tube inlets can be combatted by Flowrites, sometimes called "inserts" or "wearing sleeves." Flowrites serve as a replaceable wearing section and are fitted to the inlet ends of tubes.

Fiber Plugs

The right type of tube plug will eliminate many operating difficulties. Only fibre plugs have proven completely satisfactory. In stock for all standard tube sizes.

The "Conseco" Specialties shown here are a few of the many we have developed to simplify maintenance, reduce costs and step up performance in your steam plant. We carry these items in stock in standard sizes for prompt delivery, or special sizes can quickly be made to order. Descriptive Bulletins sent on request.

CONSECO PRODUCTS

Retubing Condensers
Evaporators
Air Ejectors
Heat Exchangers
Flowrites
Tube Plugs
Conco Plugs and Guns
Bevel Gears
Instrument Repair Service
Blackburn-Smith Filters and Grease Extractors
Metal Spray

Bulletins Available for Above Items

Conco Gun and Plugs

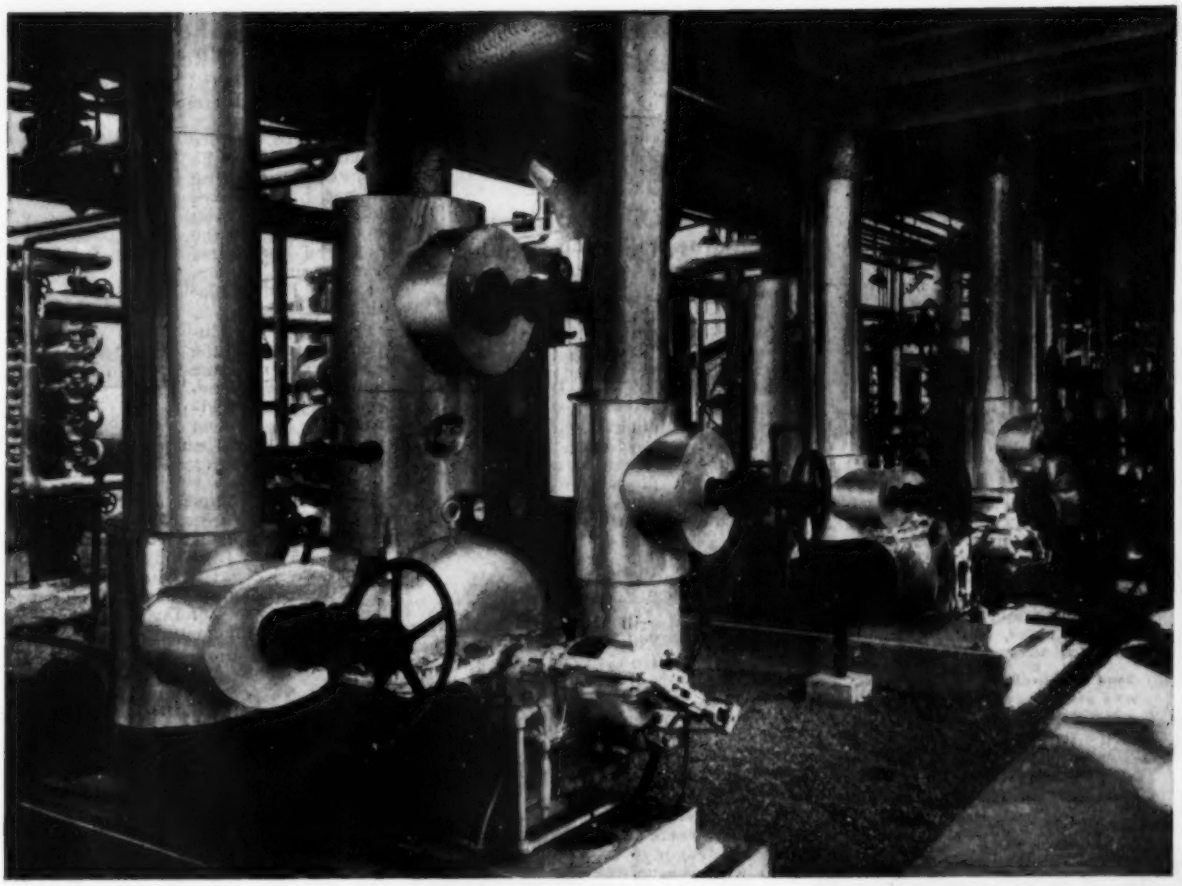
For slime, algae, vegetable matter or soft flaky scale deposits, use the hydraulically operated Conco Gun and Plug. Can be fitted with adapters and plugs for any size tube.

Bevel Gear Universal Joints

Bevel Gear Universal Joints are designed and built to give positive transmission of torsion regardless of shaft angle. A simple, flexible and economical solution to the problem of shaft line-up.

CONSECO Condenser Service & Engineering Co., Inc.

56 BLOOMFIELD STREET, HOBOKEN, N. J. HOBOKEN 3-4425—N. Y. TEL: BARCLAY 7-0600



POWER FOR DRIVING PROCESS PUMPS *plus* high-pressure exhaust steam is double benefit provided by four Worthington single-stage turbines at Ohio Oil Co., Markham, Texas.

Stay on stream...

with Worthington single-stage turbines

The Ohio Oil Company in Markham, Texas, needed drives for a group of four pumps used in the absorption, distillation and fractionating of natural gas.

Problem was, what kind of drive? This didn't remain a problem long — not after we laid out the facts on Worthington single-stage steam turbines. Ohio Oil settled fast on these job-proved units.

Now they're not only getting dependable power out of these turbines, they're also getting exhaust steam at 90 psig to use in their distillation process.

They picked Worthington single-stage turbines because these units had a reputation for doing a fine job. These turbines were selected from a complete range of frame sizes, available to meet the requirements of any single-stage turbine application.

If you'd like to know more about our steam turbines, the first step is to write Worthington Corporation, Harrison, New Jersey, for Bulletin 1953C.

T-4.4

WORTHINGTON

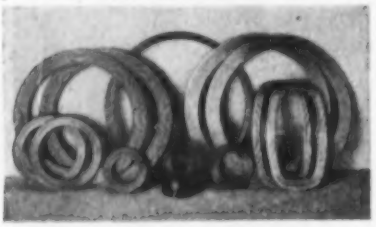
STEAM TURBINES

Single- and Multi-Stage Turbines • Turbine-Generators • Deaerators • Boiler Feed Pumps • Surface Condensers

A GREAT TEAM IN STEAM

For more data on advertised products, use Readers' Service Cards, last page.

Need Plain or Jacketed
CORRUGATED METAL
GASKETS?



Call CHICAGO-WILCOX
for PROMPT ATTENTION

Chicago-Wilcox understands the gasket requirements of refineries and is equipped to supply all types of gaskets, including plain or jacketed corrugated metal gaskets like these. Made of ingot iron, aluminum, stainless steel, copper, brass, nickel, and monel in all sizes and shapes.

Send specifications for quotations and prompt-delivery schedule.

CHICAGO-WILCOX MFG. CO.
7703 Avalon Avenue, Chicago 19, Ill
Phone SAginaw 1-1900

JET-LUBE
KOPR-KOTE
THREAD LUBRICANT and SEAL

HEAT RESISTANT

Avoid leaks in casing and tubing with JET-LUBE's high temperature KOPR-KOTE. Contains fine ground metallic copper. Hundreds of wells cased and tubed without a "leaker." Batch controlled. Fully guaranteed.

Order through your supply store or send for complete details

JET-LUBE INC.

7362 W. BEVERLY BLVD., LOS ANGELES 36

Suppliers . . .

pany, Port-au-Prince, Haiti, has been appointed exclusive representative for De Laval products in the Republic of Haiti.

U. S. Steel Oilwell Division Promotes White, Adds Gundy

D. R. White has been promoted to area merchandise manager for the Central Midwest area of United States Steel Corporation's Oil Well Supply Division. Since 1951 he has served as assistant to the district merchandise manager at Wichita Falls, Texas. He will now be responsible for inventory administration and procurement in the area.

Dean Francis Gundy has joined the division's district office at Wichita Falls as assistant district engineer—refinery and pipe line sales for the North Texas & Panhandle district.

Midwest Piping Elects Morrill Vice President

Guy L. Morrill has been elected vice president of Midwest Piping Company, Inc., of St. Louis, Mo. His election came at a recent meeting of the company's board of directors.

Morrill

Morrill will continue to make his headquarters in Los Angeles, where he has been manager of the Midwest West Coast plant since it was established in 1927. He started with Midwest as an estimator in 1921. He holds degrees from the University of Illinois and the University of Michigan.

American Cyanamid Division Names Bound Brook Plant Heads

M. N. Gaboury has been appointed plant manager and F. B. Manker assistant plant manager of the Bound Brook, N. J., plant of the Organic Chemicals division of American Cyanamid Company.

Since 1950 Gaboury has been manager of the Color department of the Bound Brook plant. Manker has been production manager of related coal tar products since 1952.

Davison Wins Merit Award From Research Institute

The annual award of merit of the Associated Member Division of the Research Institute of America, Inc., has been presented to Davison Chemical Company, division of W. R. Grace & Company.

Davison won the award for its system of "on the spot" photographs to dramatize the company's safety, good housekeeping and cost-control problems.

Leon Johnson Dies

Leon H. Johnson, chief engineer of the Warren division of Struthers Wells Corporation, died recently. He was 69.

Conoflow Adds Research Head and Southwest Representative

Warren H. Brand has been named director of engineering and research for Conoflow Corporation, Philadelphia. Before joining Conoflow he served with the Atomic Energy Commission as supervising engineer of the Industrial Instruments Engineering section at Oak Ridge National Laboratory.

Brand

Brand's new duties will include the supervision of the administrative functions of the Engineering department and the integration and expansion of present and future research and development programs.

The Watts Company of Houston has become exclusive sales representative for Cono Controls in southeastern Texas and southwest Louisiana. Ralph L. Watts, principal of the organization, worked for Taylor Refining Company, Duriron Company of Dayton, Ohio, and Small Parts Manufacturers Company of Barrington, R. I., before forming The Watts Company.

Industrial Models Forms Affiliated Firm in Holland

Industrial Models, Inc. (Del.) has announced the formation of Industrial Models, N. V. (Holland), a new affiliated company at The Hague. To produce models of oil refineries and chemical plants for the European and American markets, the new firm will be headed by David A. Parvis as managing director.

Dresser Elects DeGolyer

E. L. DeGolyer, internationally known petroleum geologist and oil executive, has been elected to the board of directors of Dresser Industries, Inc., Dallas, Texas. He is a senior member of the consulting firm of DeGolyer & MacNaughton, Dallas.

THE
PARCO COMPANY
INCORPORATED
PARCO
DESIGN PERTAINING TO
ALL PHASES OF
POWER, PETROLEUM
& CHEMICAL PLANTS
82 Beaver Street
New York 5, N. Y.

Suppliers . . .

Worthington Moves McCuaig to Application Engineering Head

Donald H. McCuaig has been appointed manager of application engineering for the Air Conditioning and Refrigeration division of Worthington Corporation.

McCuaig

McCuaig has had wide experience in the engineering field, serving as an engineer with Alabama Power Company and Frick Company, Inc., Waynesboro, Pa. He joined Worthington in 1944 as application engineer of the Air Conditioning and Refrigeration division. Since 1952 he has been manager, Central Station Equipment section of that division.

PETROLEUM REFINER Classified Ads

FOR SALE

SPECIAL LIQUIDATION!

TOWERS & COLUMNS

8′ x 61-6 stainless steel, 15 trays
7′ x 25-6 stainless steel, 10 trays
6′ x 64′ stainless steel, 35 trays
6′ x 45′ stainless steel, 850 psi
4′ x 110′ stainless steel, 70 trays
4′ x 72′ stainless steel, 45 trays
2′ x 73′ stainless steel, 50 trays
2′ x 39′ stainless steel, 30 trays
7′-6″ x 55′ steel tower, 30 trays
7′ x 42′ steel tower, 20 trays
7′ x 5′ x 70′ steel tower, 35 trays
6′ x 63′ steel tower, 35 trays
5′ x 61′ steel tower, 15 trays
4′ x 72′ steel tower, 40 trays
3′-6″ x 63′ steel tower, 35 trays
2′-6″ x 60′ steel tower, 35 trays
2′ x 75′ steel tower, 45 trays

HEAT EXCHANGERS

2—1440 sq. ft. stainless steel
75—atmospheric heat exchangers, steel and stainless in 715, 477, 358, 108 sq. ft. sizes.
2—1125 sq. ft. steel, 850#
9—Kettle type reboilers, steel and stainless 1270, 1125, 750, 660, 400, 340, 100, 80, 50, 31 sq. ft. sizes.

OTHER ITEMS

2—1380 gal. stainless steel tanks, 90 psi
3—6′ x 32′ heresite lined tanks 74 psi
60—turbine-driven centrifugal pumps, steel and stainless construction from 1″ x 1″ to 8″.
2—Pacific six-stage centrifugal pumps, 730 GPM
4—B-J stainless steel pumps, 8″ x 6″, 1500 GPM
4—I-R PVG-8 engines, driving 20″ x 18″ and 24″ x 18″ 8000 GPM I-R pumps
Union four-stage centrifugal pump, 1000 GPM, driven by Waukesha engine
3—I-R steam-driven propane compressors, 5400 hr.
2—Clark MA-4 Right angle gas engine compressors, 150 BHP
High pressure gas-fired tube still furnace, 15 Mil BTU hr.
2—Union Iron Works 30,000 Hr. water tube boilers, 200 psi, complete
Complete Oxygen plant, built by Stacey-Dresser, 170 Tons day. Complete details on request.

BRILL EQUIPMENT COMPANY
4101 SAN JACINTO STREET, HOUSTON 4, TEXAS
Telephone: JUstin 6032
A SINGLE ITEM OR A COMPLETE PLANT
Write, wire or phone us for complete information — Send us your surplus equipment lists today

HELP WANTED

Engineers

CHEMICAL ENGINEERS

Graduate chemical engineers with minimum 3 years process design experience in oil refinery or surface oil producing facilities. Equivalent graduate training acceptable in lieu of experience. For New York office. Must be willing, however, to relocate in foreign operations at some future date.

CORROSION ENGINEER

Foreign Service

Graduate Chemical or Metallurgical Engineer with minimum 10 years experience analyzing and resolving corrosion problems, 5 years of which must be in corrosion work relating to petroleum producing and refining materials and equipment.

Salaries for above positions commensurate with experience and training. Write giving full particulars regarding personal history and work experience. Please include telephone number.

RECRUITING SUPERVISOR
Box 31
ARABIAN AMERICAN OIL COMPANY
505 Park Avenue
New York 22, N. Y.

HELP WANTED

DESIGN ENGINEER

Major Petroleum Company has excellent opportunity in Engineering and Construction Department for number 2 man in Drafting Division of approximately 90 people. Must be graduate engineer (preferably Mechanical) with demonstrated ability to direct and coordinate work of drafting groups. Should have at least 10 years' experience with all phases of design, layout and drafting. Must be familiar with engineering calculations, specifications, materials, codes and engineering and construction methods, with emphasis on process piping, pressure vessel, mechanical, structural, electrical, architectural and instrument work. If you are now earning in the neighborhood of $10,000 and looking for a real opportunity to advance, send resume in confidence to Mr. H. M. Overley, P. O. Box 7258, Philadelphia 1, Pa.

CHIEF ENGINEER

Well known national engineering and construction company specializing in oil and chemical industries. Must have thorough kowledge petroleum processes and proven ability to organize and handle complete engineering department. Age preference 35-45. Headquarters Middle West. Give complete data first letter.
Reply to Assistant General Manager, Box 187-R, c/o Petroleum Refiner, Houston, Texas.

GRADUATE MECHANICAL ENGINEER

3 to 5 years experience in chemical plant or refinery design and operation required. Position will be in electrochemical plant engineering office.
Write fully giving technical background, experience, personal history and initial salary expectation. All applications will be held in strictest confidence.
DIAMOND ALKALI COMPANY
Personnel Office
P. O. Box 886, Pasadena, Texas

■ PROJECT ENGINEERS: Requires a mechanical or chemical engineering degree and at least 5 years diversified experience in petroleum and chemical plant design and development work. Will be responsible for coordination of process and design to insure customer specifications are met. There is considerable customer and vendor contact. These are permanent positions with an internationally-known organization located on the East Coast. Salaries are high, and the many employee benefits include executive insurance and a liberal pension plan. Traveling and moving expenses will be paid. Please write complete details and include initial salary requirements. Box #421, Room 1201, 230 West 41 St., New York 36, N. Y.

POSITIONS WANTED

POSITION WANTED

By master mechanic on foreign construction project, twenty-five years experience on maintenance and operation of all types of construction machinery, have worked on projects in Europe & South America. Am also qualified and capable of operating various types of heavy equipment. Available immediately, references on request, Box 186-R, c/o Petroleum Refiner, Houston, Texas.

FOR SALE

GLASSES & GASKETS

ALL SIZES TO FIT YOUR GAGES & VALVES
ERNST WATER COLUMN & GAGE CO.
***Send for Catalog,* LIVINGSTON, N. J.**

For more data on advertised products, use Readers' Service Cards, last page.

When it's a question of caustic corrosion

...Refiners find Monel effective

Wherever caustic soda is used in petroleum refining, it is apt to create a corrosion problem. Some of the most troublesome occur in:

1. Caustic regeneration in mercaptan removal processes.
2. Lube oil and wax treatment.

In both processes, Monel is widely used for equipment that must stand up under corrosion by hot caustic solutions.

In caustic regeneration, you find Monel used for the regenerating towers, for pumps, piping, preheaters and reboilers. For parts where temperatures may reach or exceed 500°F., as in evaporator tubes, Inconel is to be preferred for its superior resistance to sulfide-containing caustics.

In the large outdoor agitators where hot wax is allowed to settle, then washed free of excess caustic left after neutralization processes, Monel linings have proven to be a satisfactory solution to the corrosion problem. Both nickel and Monel equipment are used to store caustic solutions. "S" Monel, with its excellent anti-galling properties is combined with Monel in hard-to-lubricate pumps to prevent seizing.

Why Monel?

Two tests show how effective Monel is in equipment where hot caustic solutions are handled.

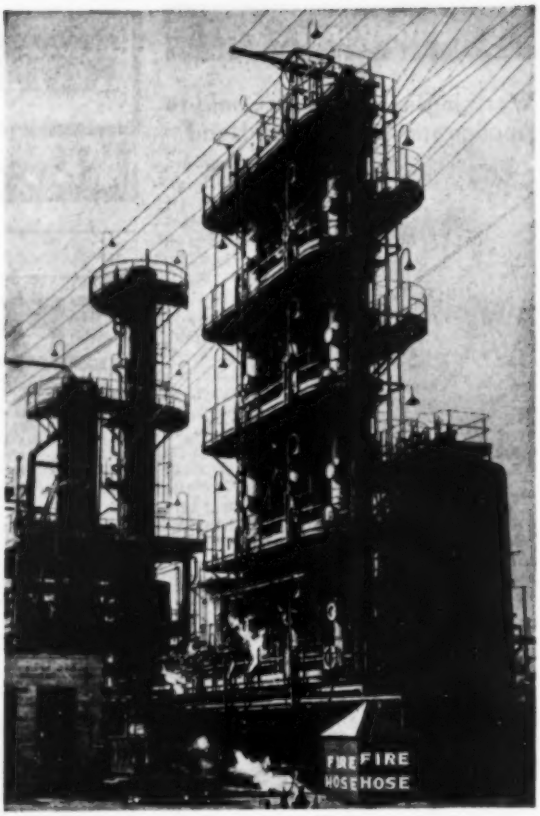
Test A — Reboiler of Caustic Soda Regenerator

Material	Corrosion rate, in. per yr.	Conditions
Inconel	0.0001	Solution contained 1-2% sodium hydroxide, 3% sodium phenolate, 0.07 mg/100 cc sodium mercaptides. Temp. 225°F.; Duration, 131 days.
Monel	0.001	
Next Best	0.017	

Test B — Vapor Section of Caustic Soda Regenerator

Material	Corrosion rate, in. per yr.	Conditions
Inconel	0.0003	Solution contained 13.2% sodium hydroxide, 0.37% sulfide sulfur, 0.80% mercaptide sulfur. Temp. 300° (Av.); Duration, 55 days.
Monel	0.002	
Nickel	0.002	
Next Best	0.013	

Have you a caustic soda corrosion (or purity) problem?
Then get in touch with Inco's Corrosion Engineering Section. Write: International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.



Regenerator Tower in Unisol* Process Installation at Atlantic Refining Company's Philadelphia refinery. In this tower mercaptan-contaminated methanol-caustic soda solution is regenerated by stripping with steam. Its solid Monel construction protects the tower from the extreme corrosiveness of the hot solution. Piping, pre-heater, and reboiler are also Monel.
*Licensed by Universal Oil Products, Chicago.

Agitator Tanks for Wax Washing, also at Atlantic's Philadelphia refinery. After neutralization by caustic and subsequent settling, wax is washed free of excess caustic with hot water in these tanks. Coned bottoms and sides to a height of 6 ft. are lined with Monel to withstand corrosion by hot caustics.

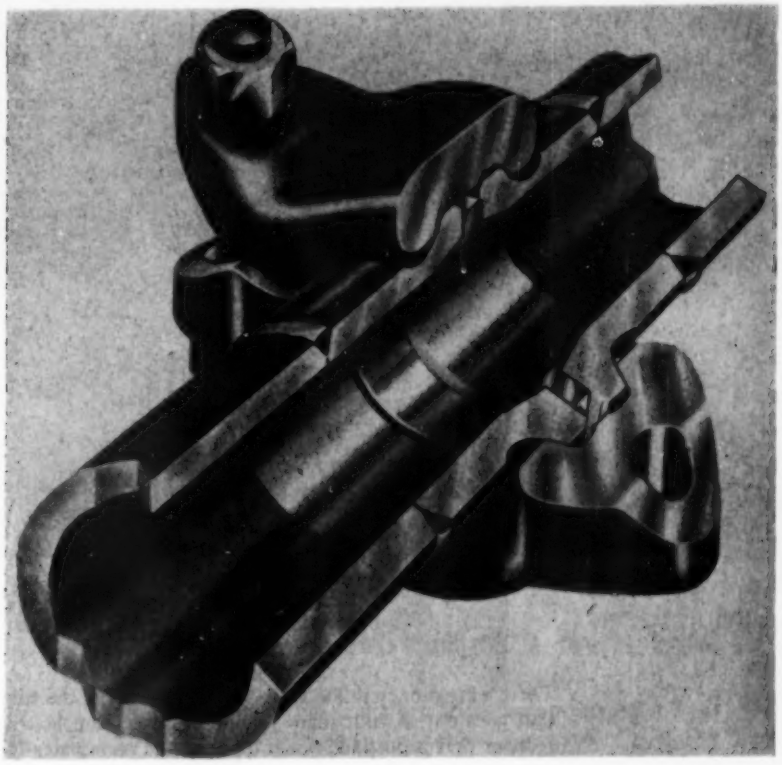
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street — New York 5, N. Y.

Monel... for minimum maintenance

Inco Nickel Alloys

What's New In Equipment . . .

One Specification Does the Job



Employing a new bolt clamp and stored energy seal, this new connection exceeds pressure limits and bending moments of heaviest wall pipe commonly experienced.

A new connection has been designed which offers industry the first "one specification" connection for all piping applications and pressure ratings. It is a "one specification" connection because it requires no selection of gaskets, facings or bolts, all parts being fully interchangeable and re-usable. Developed by Gray Tool Company, with patents applied for and registered under the trademark GRALOC, the connection employs a two-bolt clamping principle and a stored energy seal.

A steel sealing ring, having flexible lips and a rigid rib fits between the steel connecting hubs. The angle of the tapered lips of the ring is less than the tapered seats of the hubs. As the joint is made up, the lips of the seal ring conform to the seats of the hubs, thereby utilizing the elasticity of the steel as a source of stored energy to effect and maintain a positive seal. Internal line pressure serves to increase the effectiveness of the seal without creep or movement.

The rib of the seal ring affords rigidity, necessary both in handling and in preventing excessive crushing or misalignment during use, without sacrificing full bore or minimum pressure area of the connection. Further, the rib acts as a positive stop means and lends strength to resist the bursting tendency caused by fluid pressure.

Instead of the usual bolting, GRALOC uses a two-piece steel clamp which works against tapered shoulders on the connecting hubs. The clamp is held in place by two high-strength steel bolt studs made to ASA specifications. Bolting can be handled from the top, bottom or side, and the entire connection can be assembled quickly with no necessity for periodic re-tightening. Internal pressure of the line does not affect the bolting load, and over-tightening will not harm the connection.

The GRALOC connection will far exceed the pressure limits and bending moments in the heaviest wall pipe. Because it is of all steel construction, expansion or contraction does not affect the seal. It is leakproof when used with any fluid at any temperature the pipe is capable of carrying, including light hydrocarbons, steam and even low molecular weight gases.

In an independent laboratory, a 7⅛-inch bore connection was subjected to a dry nitrogen gas test, fluctuating up to 19,500 psi and temperatures up to 172 F. without leaking.

Other independent tests show that a 2½-inch GRALOC connection would be leakproof under an internal pressure of 5000 psi and a bending moment of 12,800 foot-pounds. This is approximately three times the maximum allowable bending moment that can be taken by XX strong pipe with no internal pressure. The GRALOC connection is rated at 10,000 psi internal pressure, while the same pipe is rated at 6850 psi internal pressure.

The standard GRALOC connection is about one-half the weight of a comparable 300-pound flanged connection, and one-eighth the weight of a 2500-pound flanged connection. The outside diameter and length of GRALOC connections are less than 150-pound ASA flanges.

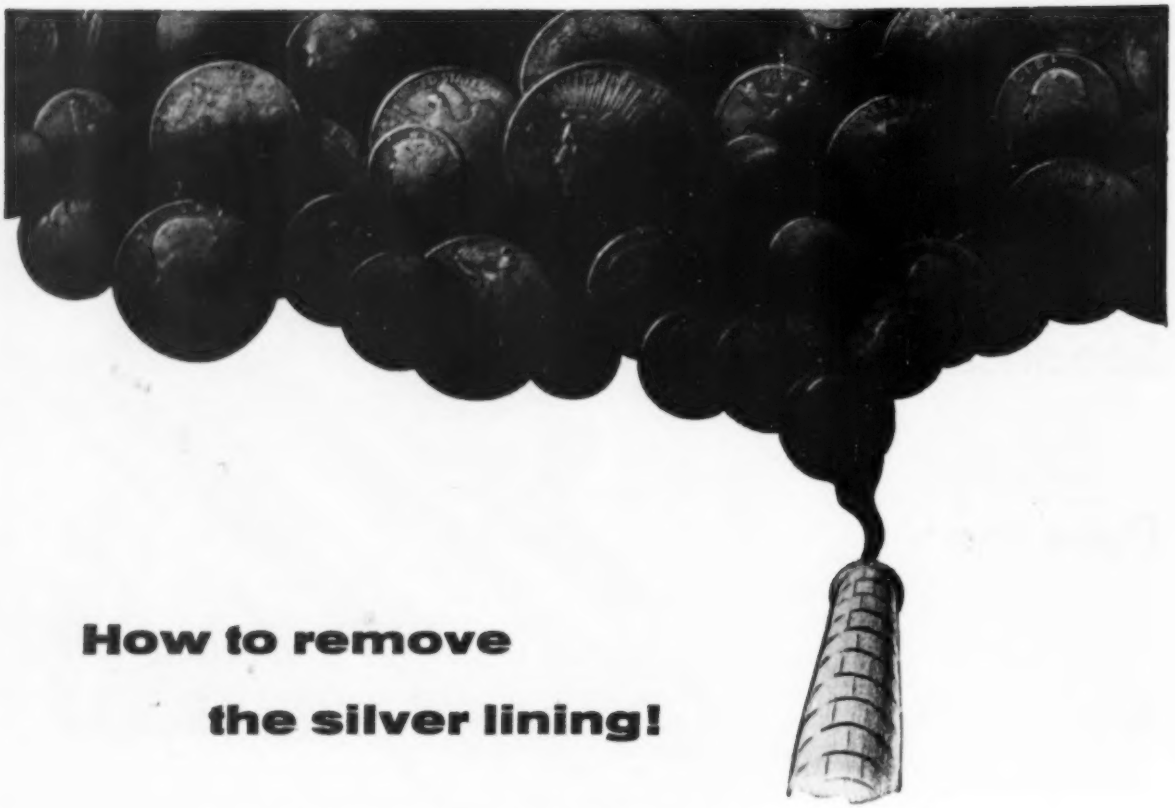
Standard GRALOC connections are made in three styles: butt welding, slip-on and threaded, in a range of sizes from 1½-inch to 12-inch for all standard weights from schedule 40 through schedule 160 or XX strong. They can be made for Super Pressure applications and of heat and corrosion resistant material.

Circle E1 on Postcard

Loading Hose

A new lightweight, flexible oil hose for use in loading and unloading tankers and barges and other dockside operations has been developed by the Mechanical Goods division of United States Rubber Company.

Called Amazon Oil Discharge Hose (H-1515), this new hose is one-third the



How to remove the silver lining!

There's big money in the valuable dust hidden in the smoke that goes out of your plant's chimney. Buell can help you recover that profit-laden dust quickly and economically... convert it into a brand new source of income.

How much? Many Buell Dust Collection Equipment Installations are recovering as much as 40 tons of valuable dust *daily*. You can see, it soon adds up into real money. During the past twenty years, Buell specialists have developed three different types of dust collection equipment. The right equipment to handle *any* dust collection problem.

That's why dozens of America's leading corporations depend on Buell to solve dust collection problems of all kinds. We will be glad to supply the names of many such users right in your own field!

Our informative Brochure – The Collection and Recovery of Industrial Dusts – explains *all three* Buell dust recovery systems. For your complimentary copy write Dept. 21-H, Buell Engineering Company, 70 Pine St., New York 5, N. Y.

buell

MECHANICAL ELECTRICAL

20 Years of Engineered Efficiency In
DUST COLLECTION SYSTEMS

New Equipment . . .

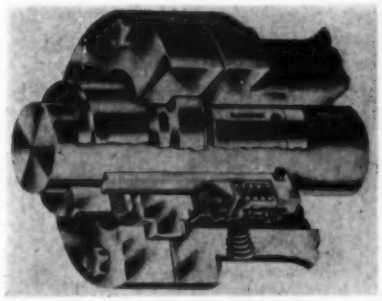
weight of conventional types.

Since the handling gear necessary for heavy hose is not required, the new hose is expected to be a boon on docks not fully equipped with mechanical handling devices.

It is exceptionally adaptable to bunkering service. This new hose has a working pressure of 200 psi and a safety factor five times as great. It is available in sizes ranging from 3- to 12-inch i.d.

This item supplements United States Rubber Company data on pages 853-872 of The Refinery Catalog, 21st Edition.

Circle E2 on Postcard



Mechanical Shaft Seal

Crane Packing Company is announcing the availability of its Type 9 seal. The Type 9 seal is mounted on a sleeve with an outside clamping ring as illustrated. This permits quick installation or removal in practically all modern split-case pumps, in that it is not necessary to unbolt the top of the horizontal split shell. This convenient maintenance feature means that in the event of a seal failure, the old seal can be removed and replaced with a new seal in a much shorter time than with conventional mechanical shaft seals. The seal can be used to handle practically all corrosive liquids at temperatures up to 500 F. Flexible sealing members can be made of Teflon. Springs and other metal parts can be furnished to meet the metallurgical specifications best suited to the particular service.

This item supplements Crane Packing Company data on page 287 of The Refinery Catalog, 21st Edition.

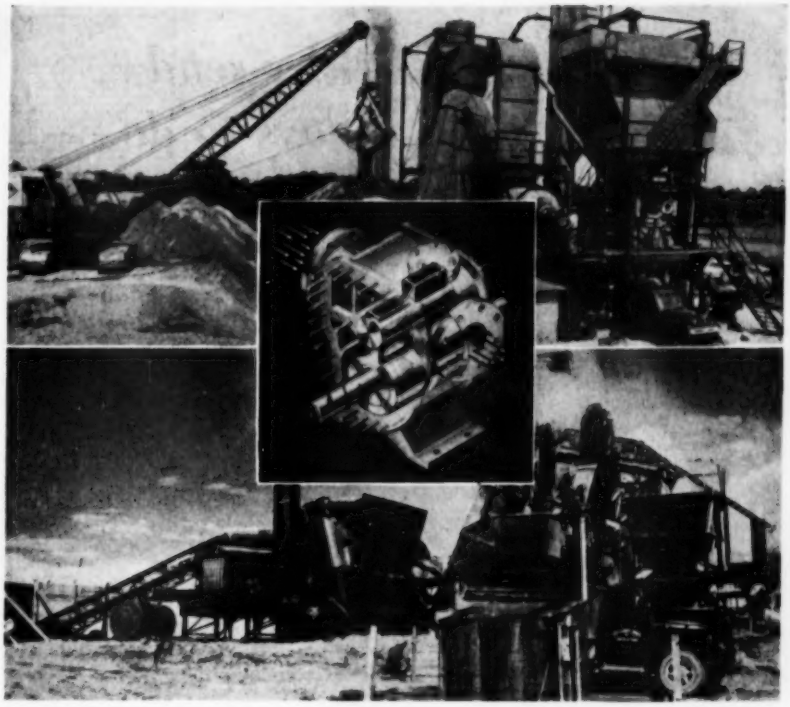
Circle E3 on Postcard

Cesium-137

Price reductions of Cesium-137 radiographic sources ranging up to more than 60 percent have been announced by Tracerlab, Inc. For example a 1 curie source, formerly $1175, is now $275 and a 6 curie source, formerly $4275, is now $1225.

These cuts have been made possible because of the lowering of the raw material prices by the AEC and because Tracerlab can now purchase cesium in quantity and encapsulate the most popular size sources for stock.

Cesium-137 is becoming widely used



THEY NEED ACCURACY AND MAXIMUM **Pumping Protection**

These asphalt mixing plants are protected against plant shut-down by Kinney Model SD Pumps . . . the positive displacement pumps of maximum durability.

Kinney Model SD Pump's rotary piston mechanism is completely free of vanes, springs, valves, and obstructions. The SD Pump has oversized, jacketed openings for suction and discharge, permitting free pumping of asphalt at lower temperatures. Because of this pump, each of these asphalt mixing plants functions smoothly and uninterruptedly . . . virtually without necessity for pump maintenance or service. The Kinney Pump's high volumetric efficiency insures accurate proportioning of asphalt into the mix. This pump also serves as transfer pump during loading and unloading periods.

Kinney Model SD Pumps are available in forty models ranging in capacities from 1½ GPM to 3000 GPM, steam jacketed in most sizes. Send coupon for details. Kinney Manufacturing Division, Boston, Mass. Representatives in principal cities of the United States and foreign countries.

Kinney

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3596 WASHINGTON STREET • BOSTON 30 • MASS.

☐ Please send Bulletin L51 describing the complete line of Kinney Liquid Pumps.

Name .....
Company .....
Street .....
City ..... State .....

For more data on advertised products, use Readers' Service Cards, last page.

Why send 8 boys to do 1 man's job?

INSTALL **CAL-FIN** TANK HEATERS

ONE foot of CAL-FIN TANK HEATER tubing has more heating surface and with viscous oils does more work than EIGHT feet of bare pipe of the same size. This means REAL SAVINGS in first cost. The low over-all height permits the fluid level of the tank to be run down as low as 36 inches and still have the heater completely submerged.

For detailed information, write for Bulletin #3005

drayer-hanson
INCORPORATED
LOS ANGELES 1, CALIFORNIA

CAL-FIN Tank Heaters are available in standard sizes up to 1,325 sq. ft., and special sizes up to 6,000 sq. ft.

New Equipment . . .

as a radiographic source material because its lower energy radiation (0.60 MEV) provides radiographs of better contrast when used on thin sections of steel and light metals such as aluminum and magnesium. Further advantages of Cesium-137 are a 33-year half life as compared with a 5.3-year half life for Cobalt-60, less expensive storage containers because less shielding is required to contain the lower energy gamma rays, lower shipping costs, and greater ease in handling the lighter containers.

For complete details on these radiographic sources, simply . . .

Circle E4 on Postcard

Solenoid Valve

Atkomatic Valve Company is now offering a new solenoid valve of stainless steel for extremely high pressures in ¼, ¾ and 1½-inch pipe sizes. The ½-inch and ¾-inch sizes are rated at 2500 psi and the 1½-inch at 3000 psi.

These valves are available for normally open and normally closed operation with bubble tight pilot valve features. Explosion proof housings are optional for use in hazardous areas. Some of the features of these new valves are:

All coils are vacuum impregnated, paper insulated to 180 F., glass insulated, silicone impregnated above 180 F.

Full ported extra rugged 316 stainless steel body to allow very high pressures.

"O" rings seal joints and protect against leakage.

For complete details on these new valves just . . .

Circle E5 on Postcard

Straddle Carrier

Clark Equipment Company is now making available a new medium-capacity Ross straddle carrier which is designed especially for plant materials handling applications.

Designated as the Ross Carrier Series

WIRE MESH

Jelliff

Specializing in the non-ferrous metals
in counts to 200 x 200 or 50 x 750
and widths up to 48" in all commercial weaves

IN MESH WITH INDUSTRY

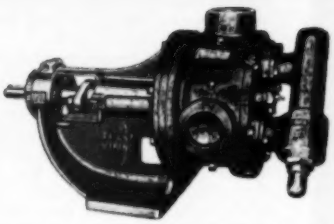
Since
1880

address your enquiries to Department 16

The C. O. JELLIFF MFG. CORP.
SOUTHPORT • CONNECTICUT • USA

WIRE PRODUCTS Jelliff SINCE - 1880

VIKING *Truck Mounting* PUMPS



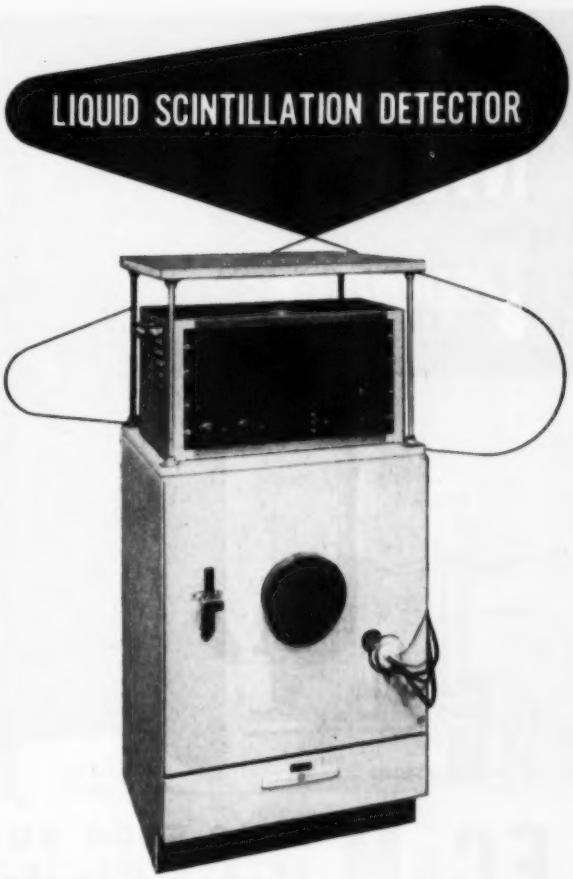
The new improved Viking Truck Mounting Pump incorporates outstanding features: an improved bracket base with extra long packing chamber; a new style double supported valve on head; a revolvable type pump case which allows complete selection of ports. Available in units from 35 GPM to 300 GPM sizes. Write for literature.

Distributor

SOUTHERN ENGINE & PUMP COMPANY

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS
Houston — Dallas — Kilgore — San Antonio
Edinburg — Corpus Christi, Texas

LIQUID SCINTILLATION DETECTOR



Tracerlab's unique CE-1 Liquid Scintillation Detector is designed primarily for counting samples of low energy beta emitters such as C-14 and Tritium, which can be prepared in liquid form. Efficiencies of approximately 75% for C-14 and 20 to 25% for Tritium can be obtained with this unit. The total sample volume is 50 cc and sample preparation is extremely simple.

An extremely low background of only 200 to 250 CPM is obtained by refrigeration of the phototubes, use of a dual-channel coincidence amplifier which passes only pulses which occur at the same time, and an overpulse rejection circuit. The two photomultiplier tubes with preamplifiers and a scintillation cell are mounted inside a lead shield in a small refrigerator. Samples may be stored in the dark before counting and a glove port permits transferring samples without exposure to light.

Booklet TL 59 contains complete details and will be sent upon request.

Tracerlab
130 HIGH ST., BOSTON
2030 WRIGHT AVE., RICHMOND, CAL.

For more data on advertised products, use Readers' Service Cards, last page.

OIL MEN Depend on:

EC&M 2200-5000 VOLT Motor Starters

These EC&M Division 1 combination Starters for Class I, Group D hazardous locations give petroleum men top-value. They require less floor space . . . line, motor and control leads are brought to conduit connection box for quick installation . . . and interrupting capacity is high . . . either 50,000KVA or in the VALIMITOR (volt-ampere-limitor) type, unlimited short circuit protection.

Oil disconnect switch (on top) may be locked open or closed, and has view windows on both sides to show switch contacts. Overload Relays of THERMAL-MAGNETIC type (mounted in conduit connection box) give accurate motor protection . . . trip instantly on faults.

Rear oil-tank has potential transformer for 220-volt push button circuit. 50,000 KVA type ZHS Magnetic Contactor may be inspected without disconnecting any bolts or leads. Contacts are copper tungsten alloy. VALIMITOR Starters, with air-core current-limiting reactors in rear tank, limit fault current to 25,000 KVA . . . ZHS Contactor clears circuit quickly. No fuses, no need to figure short possibilities . . . supply bus can be infinite KVA.

Before buying, investigate EC&M Combination Starters . . . they provide economy in installation, operation and maintenance . . . and they're complete in every respect.

1915

Write for 16-page Booklet 1062 on EC&M 2200-5000 volt starters.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79th STREET • CLEVELAND 4, OHIO

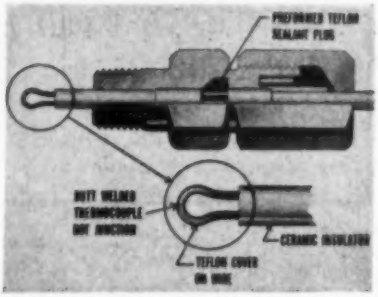
New Equipment . . .

81, the 20,000-pound capacity machine replaces the former Series 80 carrier. Some of the features of this new series are:

- Greatly improved operator's load hook visibility.
- Quick accessibility to all working parts of the superstructure, including all parts of the engine and hydraulic system.
- Accelerated operation of the hydraulic hook swing.
- Load hoisting speed increased from 18 to about 35 feet per minute.
- Over-center emergency brakes with an independent control lever for each rear wheel.

For complete details on this new series, simply . . .

Circle E6 on Postcard



Thermocouple Gland

Conax Corporation has just announced a new thermocouple gland incorporating a butt-welded thermocouple covered by a thin walled Teflon tube for protection against corrosion. This new gland (Model TG-14T) provides the corrosion resistant properties of Teflon in a fast responding thermocouple for high pressures up to 5000 psi and temperatures from —90 F. to +500 F.

The new Conax thermocouple gland incorporates a snug fitting Teflon tube slid over a butt-welded thermocouple wire. The outside of the tube is sealed in the thermocouple gland by the mechanical compression of a double-bore Teflon bushing around the tube inside the stainless steel gland. This tube is not crushed because it is internally supported by the thermocouple wire passing through it. The gland is made entirely of corrosion-resisting type 303 stainless steel.

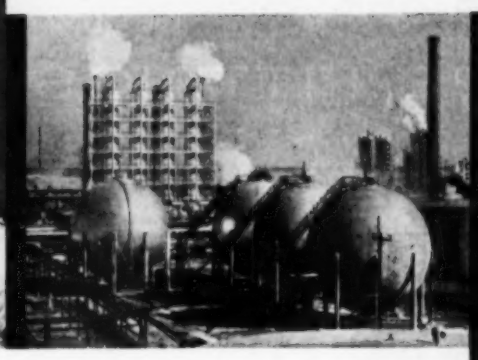
Eighteen gage thermocouple wires of either iron-constantan or copper-constantan calibration are available as standard stock items. For complete information on these new thermocouple glands, just . . .

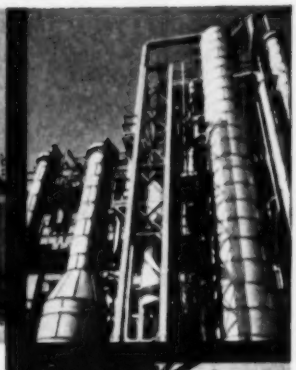
Circle E7 on Postcard

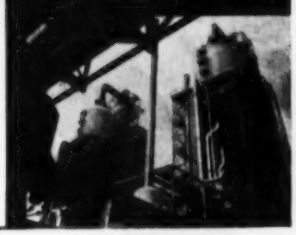
Dry Plug Valves

Wedgeplug Valve Company has announced that Wedgeplug steel dry plug valves are now available from stock equipped with a Hycar-coated plug. This special coating, bonded to the metal

All along the refinery line . . .







ENDURO IS BUSY FIGHTING CORROSION

Hundreds of refinery applications attest the unusual ability of Republic ENDURO Stainless Steel to resist corrosion. To discourage coking and fouling. To save weight and trim bulk. To contain pressures and live with heat. To last long. To keep equipment on stream.

ENDURO equipment is solid stainless steel. Has no applied surface to chip, crack, peel, or flake, and accumulate coke build-up. ENDURO equipment resists corrosion, stays easy to clean. High in strength-to-weight ratio, ENDURO can be used in thinner, lighter section. It retains its high strength at both ends of the thermometer.

Refinery suppliers are manufacturing all kinds of equipment in ENDURO Stainless and Heat Resisting Steels. Republic will put you in touch with them, and help you engineer specific applications. Write:

REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department; Chrysler Building, New York 17, New York

REPUBLIC
ENDURO STAINLESS STEEL

Other Republic Products include Carbon, Alloy and Stainless Steels — Bolts and Nuts, Steel and Plastic Pipe, Heat Exchanger Tubes

For more data on advertised products, use Readers' Service Cards, last page.

DEKORON PRODUCTS CUT INSTRUMENT TUBING COSTS

HI-DUTY
TUBE FITTINGS

DEKORON Hi-Duty® Tube Fittings are scientifically designed. Always use them with Dekoron single-line metal tubing or Metl-Cor multiple-line instrument harness — the last word in corrosion-proof instrument lines.

Hi-Duty fittings make leak-proof joints that withstand major tube movement and vibration. No flaring or special preparation of tubing is needed. This means Hi-Duty fittings install easier and faster . . . cut installation costs up to 71 percent. Most sizes available in brass, aluminum, steel and 316 stainless.

Pressure tightness . . . installation savings . . . quality — *you can't beat Dekoron Hi-Duty Tube Fittings.* Request Bulletin L-9335.

A-9005

Dekoron® products

quality research service SAMUEL MOORE & COMPANY • MANTUA, OHIO
DEKORON PRODUCTS DIVISION

New Equipment . . .

under pressure and temperature, is a plastic material designed to maintain a tight seal and high resistance to abrasion and corrosion. Some of the recommended special services for these new valves are: petroleum oil service, liquefied petroleum gases, gasoline, kerosine, air, gas, water, acid and alkaline solutions, and saturated salt solutions. Use of this special coated plug is recommended for operating temperatures between —40 and +200 F. The new Wedgeplug valves with special coated plugs may be obtained in three types: wrench operated, hand wheel operated, and gear operated. For complete details on this new valve, just . . .

Circle E8 on Postcard

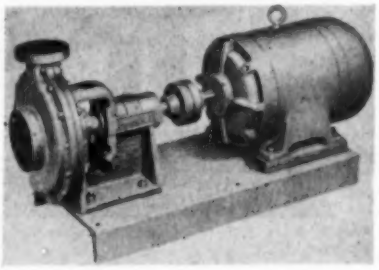
Chemical Pumps

The Roy E. Roth Company is announcing a new line of end-mounted chemical pumps for acids, caustic solutions, solvents, and liquefied gases. The line consists of 27 models suitable for heads up to 600 feet in a single stage and capacities from 1 to 100 gpm.

All models are equipped with high pressure flanged connections and are available in 316 stainless steel, 304 stainless steel, cast carbon steel, Hastelloy "C," Duramet 20, and nickel, as well as bronze and cast-iron. Seven different types of mechanical seals are furnished, each in several combinations of metals and gasketing.

Each model is rated individually for its NPSH characteristics at a variety of discharge heads. Complete information is available now. Simply . . .

Circle E9 on Postcard

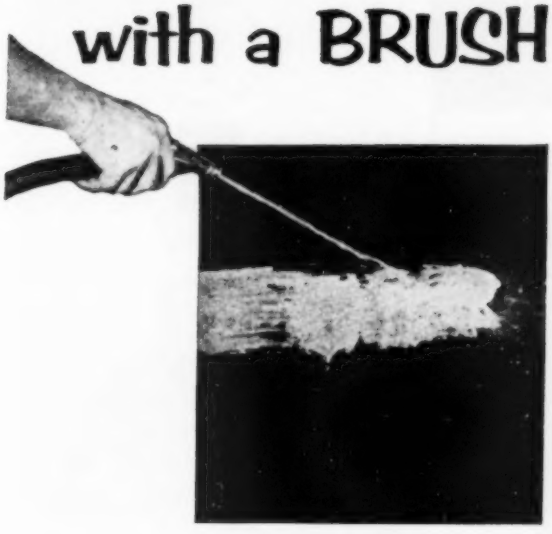


Rubber Lined Pumps

Industrial Filter & Pump Manufacturing Company is announcing an improved line of vulcanized-rubber lined centrifugal pumps. These pumps are especially designed for severe, continuous service in handling corrosive and non-corrosive liquids in the refining, natural gasoline and petrochemical industry. Lined with soft rubber for abrasive slurries or hard rubber as specified, the balanced rotating assembly is mounted in ball bearings. Corrosion-proof stuffing box to permit external liquid seal if required; easily removable packing gland nut and ample space for repacking stuffing box; simple adjustment of impeller clearance are some of the construction

For more data on advertised products, use Readers' Service Cards, last page.

strip paint with a BRUSH



Take a stop watch in one hand and a brush full of Oakite Composition No. 57 in the other and see for yourself how this amazing new paint stripper goes to work in seconds . . . practically lifting the paint behind the brush.

See how Oakite Composition No. 57, paint stripper extraordinary, clings to vertical and inverted surfaces, eliminating costly waste. How easily loosened paint rinses away with water pressure spray.

Oakite Composition No. 57 is tops for removing those tough alkaline resistant paints from surfaces that just can't be dip-stripped. Get the full story today by writing for Special Report B-2415 and the Paint Stripping Handbook F-7893. Both FREE. Write Oakite Products, Inc., 50B Rector Street, New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

MATERIALS • METHODS • SERVICE

Technical Service Representatives in Principal Cities of U.S. & Canada

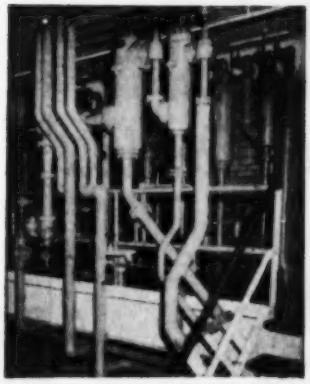


Photo Courtesy of Hoffmann-LaRoche, Inc., Nutley, N. J.

LET C-R EVACTORS help improve your health

This illustration shows two 4-stage Evactors in the plant of a leading manufacturer of vitamins and other pharmaceuticals. The same plant uses numerous other C-R Evactors of different types—as do the majority of manufacturers in this important field—for many different processes, including deodorizing, distilling, drying, refrigeration, etc. They are as simple as the valves that turn them on, yet maintain absolute pressures down to a small fraction of 1 m.m. absolute where steady, dependable vacuum is extremely important.

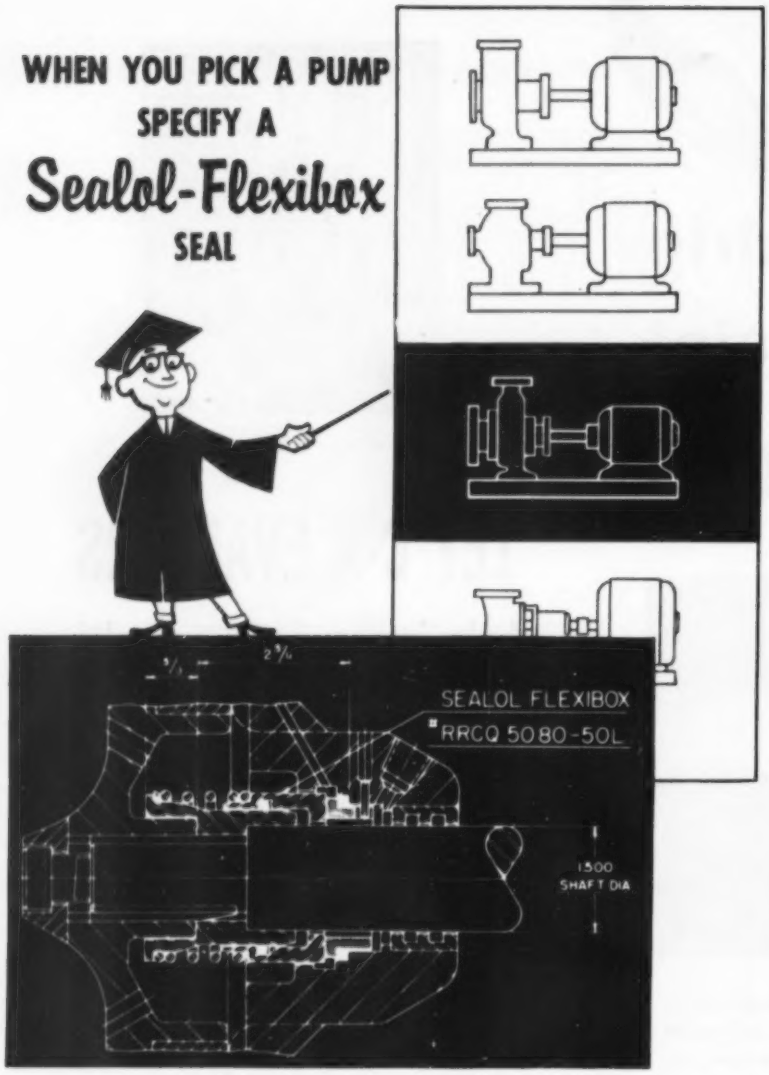
This steady, dependable vacuum is contributing to the improved health of our population by helping to supply purer and more potent vitamins, antibiotics and other pharmaceutical products. It is contributing indirectly to the health of many operators and executives in other manufacturing industries, by minimizing worry over vacuum problems. This also applies to Jet Mixers, Jet Heaters, Jet Absorbers, Jet Scrubbers, Jet Pumps, Jet Condensers and Barometric Condensers.

CROLL-REYNOLDS

Croll-Reynolds Co., Inc.

Main Office: 751 Central Avenue, Westfield, N. J.
New York Office: 17 John St., New York 38, N. Y.
CHILLVACTORS STEAM JET EVACTORS CONDENSING EQUIPMENT

WHEN YOU PICK A PUMP
SPECIFY A
Sealol-Flexibox
SEAL



No single pump feature makes as much difference in safety, freedom from maintenance, and peace of mind as the Sealol-Flexibox Mechanical Shaft Seal. Pumps with built-in Sealol-Flexibox Seals have less shaft overhang . . . the distance between pump impeller and shaft bearings is greatly reduced. This means less shaft distortion, longer bearing life, and less maintenance.

The Sealol-Flexibox Seal itself is virtually maintenance-proof. It has a patented spring drive which insures uniform loading over the entire 360° area of the seal face. This unique spring drive has proven itself in thousands of installations under an extreme range of speeds, temperatures, and pressures.

Sealol offers a wide range of Sealol-Flexibox designs to meet your particular service requirements . . . for stuffing box replacement, for designed-in pump installations, or for special applications. Send for Bulletin 9 and complete details — or write us about your own shaft sealing problem. Sealol Corporation, 13 Willard Ave., Providence 5, R. I.

SEALOL

NEW YORK CITY • PHILADELPHIA
CHICAGO • CLEVELAND
HOUSTON • SAN FRANCISCO
LOS ANGELES • KANSAS CITY (MO.)
CHARLESTON (W. VA.) • ST. LOUIS
TULSA • EDMONTON — TORONTO, CAN.

THE ▲ BALANCED PRESSURE SEAL

New Equipment . . .

features.

These pumps are available in a range of sizes with capacities up to 240 gpm. and operating heads of 240 feet. They can be furnished either with or without base, motor, and coupling.

For complete details on this new line of pumps, simply . . .

Circle E10 on Postcard

Air Supply Filter

A compact air filter designed to prevent dirt, oil, water and other foreign matter from entering pneumatic instruments has been announced by The Foxboro Company.

The new filter consists of four major elements: a top cap with supply and outlet connections; a chamber with a drain cock at the bottom; a resin impregnated filtering sleeve; and a water baffle. The unit which measures approximately 8½ inches by 4⅛ inches is designed to be mounted either in a supported line or bolted to a wall or panel.

Filter capacity is 4 cfm of air or natural gas. The sump capacity is 12 cubic inches; filtering area, 21.2 square inches; and maximum working pressure, 150 psi. Supply and outlet connections are ¼-inch NPSF.

Complete specifications and description are available now. Just . . .

Circle E11 on Postcard

Truck Winches

Two new 7000-pound truck winches for standard and low mounting have been announced by Gar Wood Industries. Standard-mount winch Model 7S is designed for installation behind truck cabs. Low-mount winch Model 7L mounts

For more data on advertised products, use Readers' Service Cards, last page.

Sure,
that old pump
still works,

but how much does it cost to keep?

That rugged old pump of yours may not be the bargain that it seems. Let's do some arithmetic. If the efficiency of the old pump is 75% vs. the 85% efficiency of the new pump, you are paying more to keep it than you would to replace it. That's because a new unit of equivalent output uses less power. Thus it soon saves its own cost — then begins to pay dividends.

Let's take a specific example—a general service pump

Old pump efficiency 84%	**625 BHP**
New pump efficiency 89%	**590 BHP**
	35 BHP Saving

On the basis of 1¢ per KWH, the 35 BHP saving for a 5000-hour year (approximately 14 hours per day) amounts to $1300. This saving, capitalized in 4 years at 4% adds up to $5520. Yet the price of the new pump that saves $5520 is only $4054.

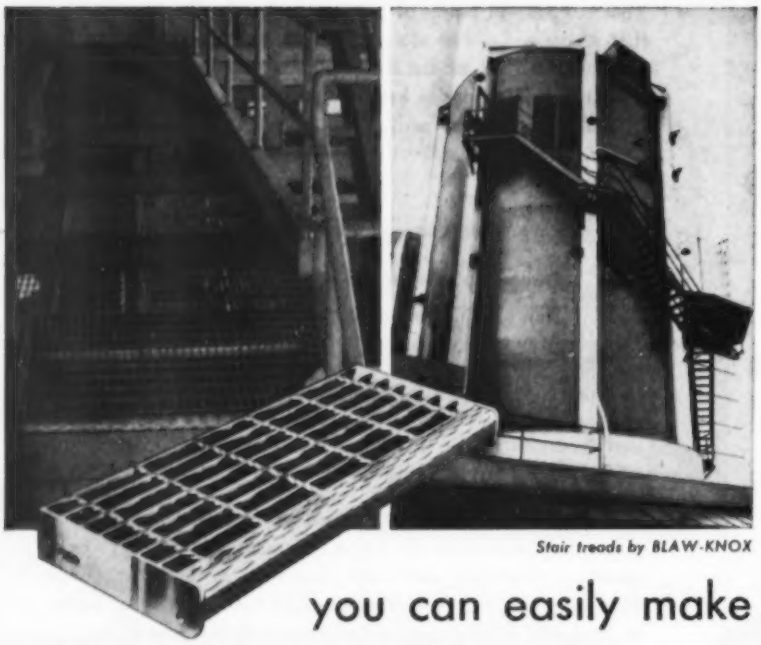
What would the pump replacement profit be in your particular case? Your De Laval representative can tell you exactly — in dollars and cents — as soon as he has the basic facts on your present installation. Call him in today or write to De Laval for Pump Fax Bulletin which includes a valuable "power-savings" chart.

DE LAVAL *Pumps*

DE LAVAL STEAM TURBINE COMPANY
811 Nottingham Way, Trenton 2, New Jersey

DL-137C

For more data on advertised products, use Readers' Service Cards, last page.



Stair treads by BLAW-KNOX

you can easily make

every step a safe step

Indoor or outdoor, you can rely on Blaw-Knox Stair Treads to provide the safety you want in your plant.

Designed for tremendous strength against impact, these stair treads are made with twisted cross bars and rolled diamond checkered plate nosing—as illustrated.

But, when desired, you can get treads with a twisted cross bar nosing or an abrasive nosing. And for specially slippery conditions we can supply you with serrated cross bar treads.

Just tell us what your application is and we'll offer our recommendations as to the best type of tread for your job.

Only Blaw-Knox Electroforged® Steel Grating and Stair Treads —have these five exclusive features:

1. **rigid one-piece construction—easy to install**
2. **all surfaces accessible—easy to paint**
3. **no sharp corners to clog—self-cleaning**
4. **maximum open area—for light and ventilation**
5. **non-slip twisted crossbar—safe footing**

A short note will bring you a copy of new Bulletin No. 2365-R —a dimensional sketch will bring you a quotation.

BLAW-KNOX

BLAW-KNOX COMPANY
2005 Farmers Bank Building • Pittsburgh 22, Pa.

BLAW-KNOX EQUIPMENT DIVISION
GRATING DEPARTMENT

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating.

New Equipment . . .

in front or at rear of truck chassis, or back of cab. The low-mount winch, a space saver, allows the entire truck platform to be used for the payload.

Both winches incorporate exclusive manufacturing advancements designed to give big winch dependability and safety as well as longer life with minimum maintenance.

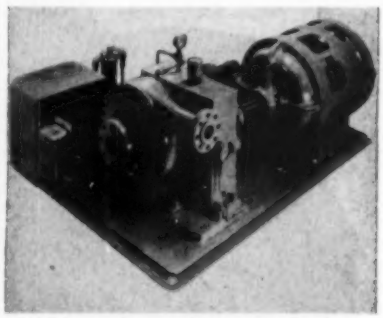
One of the most important features of the new winches is that the clutch is lubricated and fully enclosed in the gear case to protect against weather and dirt. Free clutch control operation is assured at all times because of this construction.

An exclusive, simple to operate rope clamp is built into the drum, eliminating u-bolts or other projecting devices used on drums to secure cables. Because the cable can't be fouled by the rope clamp, cable breakage and wear are reduced to a minimum.

A self-energizing safety brake automatically stops and holds any load up to winch rating in hoisting operations. This brake is in a housing attached to the gear case and is easily adjusted externally. The winches are available with manual controls at the winch or flexible cab controls.

To get complete details on these new winches, simply . . .

Circle E12 on Postcard



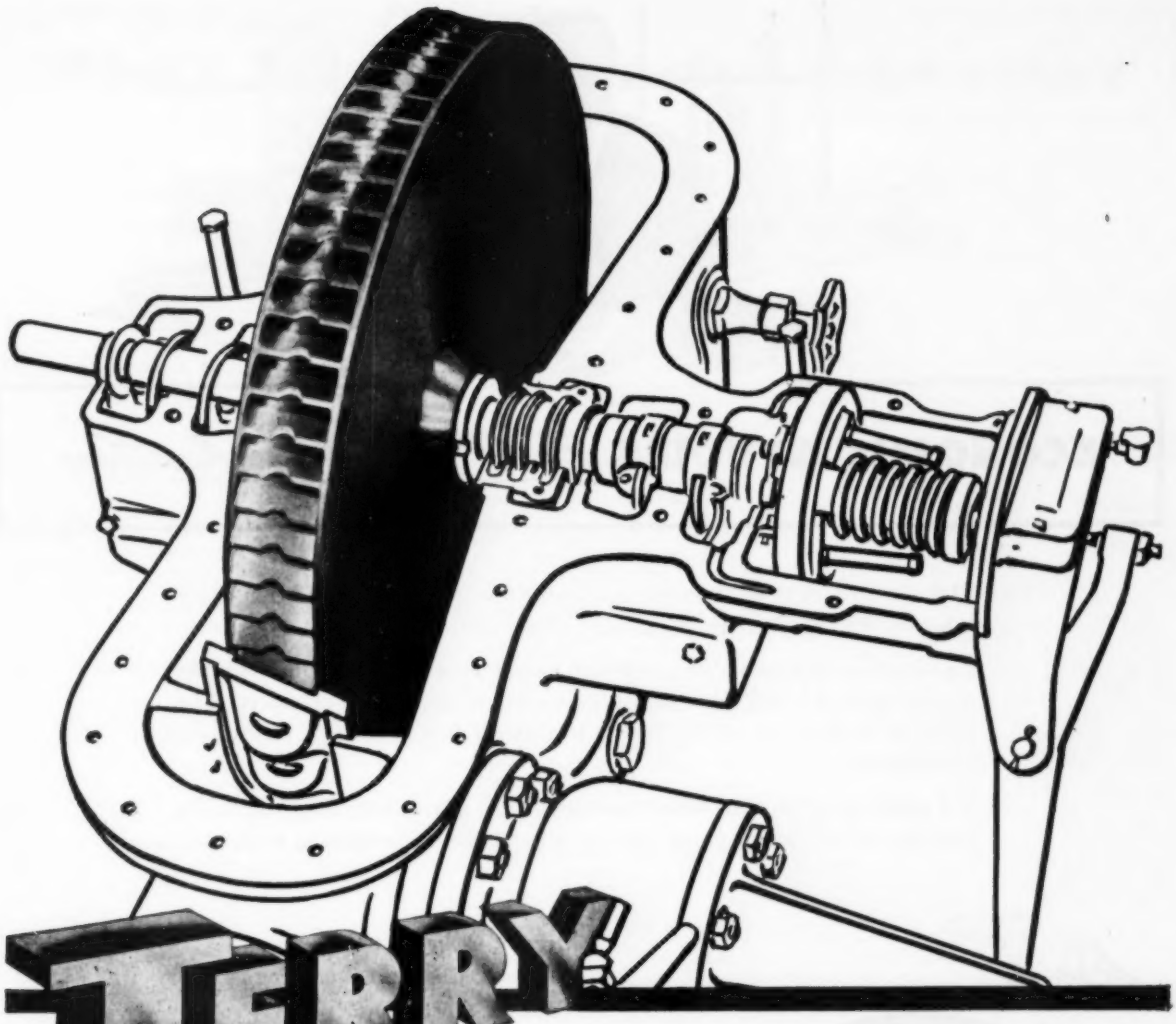
Centrifugal Compressor

The availability of a standard line of low flow, high pressure, centrifugal compressors is announced by Sawyer-Bailey Corporation. This line of compressors is designed to meet all re-cycle requirements and arrange from 25 to 250 hp, flows as low as 100 scfm, pressures as high as 600 psi and temperatures up to 700 F. One of the main features of this new line is the standardized design of impellers, housing, diffusers, bearings, gears and shafts which are interchangeable to meet the special requirements of the user. Other features are:

- Simplicity of construction.
- Minimum number of wearing parts.
- Less costly foundations.
- Reduced floor space.

These compressors can be constructed of special materials to meet particular application requirements. Drives, such as electric motors, steam turbines, gas turbines, diesel or gasoline engines, can be furnished mounted on a common base with the compressor. Technical information and performance characteristics are available now. Just . . .

Circle E13 on Postcard



TERRY

SOLID WHEEL RUGGEDNESS

is your turbine dividend

The rugged construction and fool-proof design of a Terry solid-wheel turbine can save you money by keeping maintenance costs to a minimum. Usually only taken down for routine inspection, any repairs that must be made are of relatively simple nature, and cost of replacement parts is small.

The rotor of the turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

It is impossible for the blades to foul. They have large clearances and are further protected by the projecting rims of the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry solid-wheel turbine is an extremely reliable piece of equipment—why not write for complete details today? Ask for a copy of Bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

17-1198

For more data on advertised products, use Readers' Service Cards, last page.

ECONOMIC STUDIES *For Process Evaluation*

"Are we sure we're on the right track—process wise?" . . . a question every company asks itself when planning a new plant or unit.

Usually there are available more than one process for coming up with the desired end-product with or without certain desired by-products. The problem then is to decide which method is best when all factors are considered.

We offer our services in connection with such evaluation, bringing to the problem a very broad experience in many fields of processing such as:

Organic Chemical Synthesis

Inorganic Chemical Processing

Catalytic Operations

Solvent Purification

Separation and Refining of Organic Chemical Mixtures by conventional, azeotropic and extractive distillation, liquid-liquid extraction, crystallization

Petroleum Processing:
Topping and Vacuum Distillation
Lube Oil Units

Coal Tar Distillation

Gas and Vapor Recovery

Pharmaceuticals

Should you contemplate employing outside services for a study of all factors leading to a sound process evaluation, we'll be glad to discuss how we might be of help to you.

BADGER MANUFACTURING COMPANY

230 BENT STREET, CAMBRIDGE, MASS. • 60 EAST 42nd STREET, NEW YORK 17, N. Y.

What's New in Manufacturers' Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.

Maintenance Cleaning

How-to-do-it charts, based on actual in-plant maintenance procedures, are a feature of the new "Plant Maintenance Cleaning Guide" recently published by Oakite Products, Inc.

Designed for quick reference, the charts list recommended cleaning materials, methods of application, concentrations and temperatures for such specific operations as cleaning and treating the water, air-conditioning and refrigeration units; cleaning compressors and condensers; de-scaling diesel water jackets and water-cooled furnaces; cleaning floors, oil heaters and coolers; stripping paint from machinery and transformers; and removing rust.

In addition, the booklet describes Oakite cleaning materials, Oakite solution lifting steam guns, and Oakite's hot-spray unit.

Copies of this compact, handy, 12-page booklet are available now. Just . . .

Circle E14 on Postcard

Coupling Booklet

Titeflex Company has just published a 16-page booklet describing a quick connect-disconnect hose coupling for water, oil, steam, gas and chemical lines. This bulletin describes the simple construction of the Titeflex quick-seal coupling and points out how this construction is designed to provide a unique sealing and full swiveling action which makes the coupling tighter as internal pressure increases, and prevents hose twisting and kinking. Also described in the bulletin are single and double check valve modifications of this coupling. In addition, the bulletin lists the company's regional sales office through which this new coupling will be marketed. For your copy of this new bulletin, simply . . .

Circle E15 on Postcard

Demineralization

A most comprehensive treatment of the subject of demineralization is contained in a new 24-page bulletin now being made available by Graver Water Conditioning Company. Chemical and mechanical factors entering into the design and operation of demineralizing plants for obtaining the highest quality process water and boiler feedwater from a wide range of water supplies and under many different operating conditions are fully explained.

Of special value to readers is a section concerned with estimating chemical operating costs of various demineralizing systems. Cost in cents per thousand gallons net water to service can be read directly off an easy to understand curve using information derived from chemical conversion tables in a simple procedure which is outlined in the bulletin.

The characteristics of two-bed demineralizers with and without silica removal, and a mixed-bed demineralizer with silica removal are shown schematically. In addition, a two-page chart presents diagrams of six modifications of these three basic types, and their applications and relative advantages. There is also a discussion of carbon dioxide removal by degasification.

Information on flow meters and conductivity measurement for electrolyte concentration is given as well as a detailed description of equipment necessary for fully automatic operation of demineralizer.

Your free copy of this bulletin is available now, just . . .

Circle E16 on Postcard

Maintenance Bulletin

A new publication, "Five steps to Productive Maintenance," has been announced as available from General Electric Company.

The 18-page bulletin provides detailed information on organizing to meet the demands that automation will make on your electric maintenance program. Some of the steps discussed include:

- Gathering equipment data.
- Determining extent of routine maintenance.
- Establishing a routine operating control system.
- Evaluation for critical maintenance.
- Establishing a critical maintenance program.

To receive your copy of this new bulletin, just . . .

Circle E17 on Postcard

Alloy Bulletin

A new 48-page bulletin for users and potential users of stainless and heat resistant alloys in cast form has just been released by International Nickel Company.

Typical compositions of regularly produced alloys, with their applications, limitations and the types of service for which they are suitable, are discussed. Over 175 photographs illustrate applications of typical alloys by industry. Charts compare creep strength of various alloys, resistance to corrosion in certain media, and oxidation at elevated temperatures. Tables of composition list principal Alloy Casting Institute designations, as well as certain proprietary alloys.

To receive your copy of this most informative booklet, simply . . .

Circle E18 on Postcard

Motor Pump Booklet

A very interesting and informative booklet, dealing with the selection of the proper motor pump for any specific job, has just been published by Ingersoll-Rand Company. Actually, this booklet is a slide film presentation in printed form.

The booklet gives a brief description of what a centrifugal pump is, and how it works. Then it points out the various factors, such as the quantity, pressure, friction losses and head that must be considered in selecting a pump to meet a specific installation. It also gives a typical problem and its solution by means of material shown on previous pages, such as charts and curves of various forms.

To receive your copy of this informaformative bulletin, simply . . .

Circle E19 on Postcard

Heat Exchanger

The Lummus Company has just issued a new booklet on its Heat Exchanger division. This booklet is intended to acquaint the refining, natural gasoline and petrochemical industries with the work that has been done by the company in designing, engineering, and fabricating to meet with its standards.

Thoroughly illustrated, the booklet carries you through the operations required in the manufacture of this type of equipment. It is available from The Lummus Company now. Just . . .

Circle E20 on Postcard

Flow Meters

The Industrial Division of Minneapolis-Honeywell Regulator Company has just released a new catalog which describes all of its types of flow meters. The catalog includes indicating, recording, integrating and controlling instruments of both evenly graduated and square root types, as well as area meters and differential converters. Also included is a section on flow approximations and installation information. To receive your copy, just . . .

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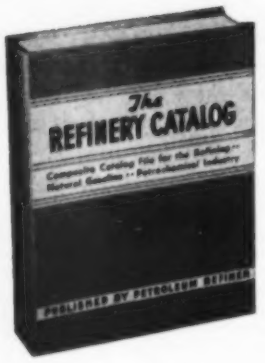

*The asterisk preceding name of advertiser indicates that detailed data on products and services of the firm will be found in The 1954 Refinery Catalog.

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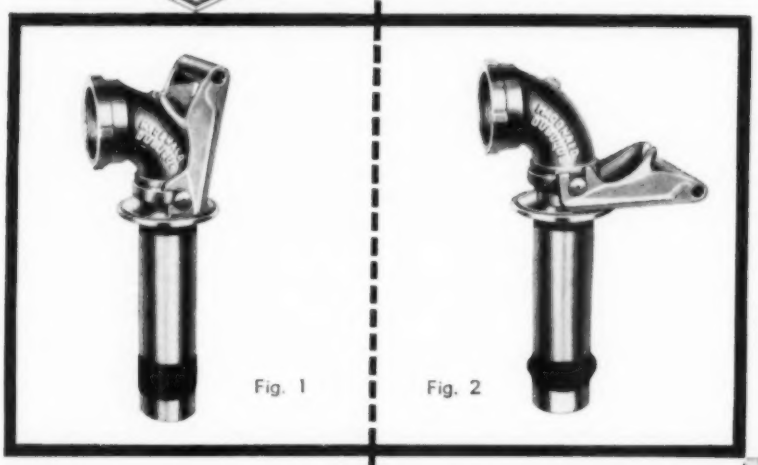

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